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Officer career paths and the effects of commissioning sources on the survival patterns of Army officers

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MONTEREY, CALIFORNIA

THESIS

OFFICER CAREER PATHS AND THE EFFECTS OF COMMISSIONING SOURCES ON THE SURVIVAL PATTERNS OF ARMY OFFICERS

by

Erkan Doganca

September 2006

| Thesis Co-Advisors: | Stephen L. Mehay |
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**OFFICER CAREER PATHS AND THE EFFECTS OF COMMISSIONING
SOURCES ON THE SURVIVAL PATTERNS OF ARMY OFFICERS**

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Submitted in partial fulfillment of the
requirements for the degree of

MASTER OF SCIENCE IN MANAGEMENT

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This thesis analyzes the career paths of U.S. Army officers and evaluates the effect of commissioning source on their survival patterns. Data used in this study are taken from the Active Duty Military Master File provided by the Defense Manpower Data Center (DMDC). The data set contains information on 103,501 officers who were commissioned between 1981 and 2001.

The results indicate that commissioning source, occupation (except for the special occupations and military police) and occupation category have significant effects on the survival curves of U.S. Army officers. Officers graduating from the ROTC Scholarship program and commissioned through Direct Commissioning have 10% and 19% greater hazards of leaving than USMA graduates; officers graduating from ROTC Non-Scholarship and OCS have 6% and 8% lower hazards of leaving than USMA graduates. Age, race and ethnicity, gender, marital status, number of non-spousal dependents, and graduate education all have significant effects on the survival function. Higher age at commissioning, being African-American, being married, each additional non-spousal dependent, and having a graduate degree have positive effects on survival patterns while being female has a negative effect. Being prior enlisted is not statistically significant in all of the models, but when it is significant, it has a positive effect on the survival function.

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I. INTRODUCTION

The strength of an army is measured by the value of its officers and its commanders.

— Mustafa Kemal ATATÜRK

A. BACKGROUND

There are four main paths to becoming a commissioned officer in the United States Army:[1]

- United States Military Academy (USMA)

- Reserve Officers' Training Corps (ROTC)

- Officer Candidate School (OCS)

- Direct Commission

All of these commissioning sources have different durations of training and instruction, and different costs. The USMA requires 24-hour a day instruction and training over a four-year period. The Army ROTC is a four-year, part-time program. OCS programs are full time and the duration varies from 10 to 16 weeks. Direct Commission officers complete a three-to-five-week course before being commissioned. In addition to the different lengths of the programs, the cost per graduate varies among commissioning sources. Federal government cost per graduate is $340,000 for service academies while it is $86,000 for ROTC programs. Cost for an OCS graduate is $32,000. Direct Commissioning officers have the lowest cost per graduate.[2] The reason for the high cost for academy and ROTC is the length of the programs when compared to OCS and Direct Commission.

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[1] The following source is used for the costs, duration of programs and service obligations in this part of the study: Michael R. Thirtle, *Educational Benefits and Officer-Commissioning Opportunities Available to U.S. Military Service Members*, (Santa Monica, CA: The RAND Corporation, 2001), 11–21.

[2] The cost of the professional training prior to entering through the Direct Appointment program is not included in this cost.

After commissioning, academy graduates have a service obligation of eight years, at least five years of which must be on active duty. The service obligation for ROTC graduates is also eight years. The active duty portion depends on whether the officer received a scholarship or not. If the officer received a scholarship, the active duty service obligation is four years. However, if the officer didn't receive a scholarship, it varies from two to three years. OCS graduates have a service obligation of eight years, four years of which should be on active duty.

At the end of each commissioning program, except for the Direct Commissioning officers who gain rank based on their occupational specialty, all of the officers receive commissions as Second Lieutenants. The output of the commission programs is the same whereas the cost per graduate varies greatly. At this point, determining if there is a difference in performance among the graduates of different commissioning sources becomes important. One way to do this is by looking at the service time of the commissioned officers. If the officers who are commissioned through a particular commissioning source have longer service times than those from other sources and if the relative cost per graduate is similar for all sources, then the Army might choose to rely more heavily on the source that provides officers who serve longer. However, there are differences in cost per graduate among the commissioning sources, as described above, so the Army must weigh the cost per graduate by the expected time in service in making decisions about the mix of commissioning sources it utilizes. This study looks at the survival patterns of Commissioned Army officers and determines if commissioning source has a significant effect on the length of the time that commissioned officers stay in the military. This issue is important because, as more and more officers leave the military and need to be replaced, manpower costs increase. Training costs have a large role in total manpower costs.

B.   RESEARCH QUESTIONS

The goal of the research is to analyze the career paths of Commissioned Army officers and evaluate the effect of commissioning source on their survival patterns. The following research questions are addressed in the study:

- What are the effects of commissioning sources on the survival patterns of commissioned Army officers?

- Are there other factors that affect the survival of commissioned Army officers?

- Do the effects of commissioning sources on the survival patterns differ between Army and Navy officers?

C.   METHODOLOGY

First, the career paths of Army officers and the structure and composition of the Army Officer corps are described. Second, the commissioning sources for Army officers are discussed. Then, statistical survival analysis techniques are used to identify and explain survival patterns for Army officers and evaluate how these patterns vary by commissioning source while controlling for demographic and military background characteristics.

Data used in this study are taken from the Active Duty Military Master File provided by the Defense Manpower Data Center (DMDC). The data set contains information on 103,501 officers who were commissioned between 1981 and 2001.

D.   STRUCTURE OF THE STUDY

This study consists of eight chapters. Chapter I is the introduction. Chapter II describes the career paths of United States Army Officers in four parts. The first part of Chapter II discusses officer personnel management, while the second part describes officer career development. Career branches and functional areas are explained in the third part. The last part of the chapter is about officer career fields. Chapter III discusses the commissioning sources for Army officers. After a brief overview, it gives information about the United States Military Academy, Reserve Officers' Training Course, Officer Candidate School and Direct Commissions in detail. Chapter IV reviews prior studies that are related with this study. Chapter V addresses the methodology. After explaining survival analysis and giving information about the survival procedures that are used in the study, it describes the variables and the model specification. Chapter VI describes the structure of the data, provides descriptive statistics about the data and explains the data's limitations. Chapter VII presents the results of survival analysis in three parts. Each part

presents the results of one of the three survival analysis procedures used in the study. Chapter VIII includes the summary, conclusions and recommendations. The conclusions section includes a comparison of the findings about the commissioning sources of Army officers with the previous findings about the commissioning sources of Navy officers.

II.   CAREER PATHS OF UNITED STATES ARMY OFFICERS

This chapter consists of four main parts. The first describes the Officer Personnel Management System (OPMS) and career management. The second discusses officer career development, and the third gives information about career branches, functional areas, and officer life-cycle developments. The final part of this chapter discusses officer career fields.

A.   OFFICER PERSONNEL MANAGEMENT SYSTEM AND CAREER MANAGEMENT

The current national security environment is dynamic. It changes quickly and becomes more and more complex. Military officers should have the knowledge, skills, and abilities that are important in such an environment. Therefore, effective officer career management is very important for the armed forces. An effective officer career management system should:[3]

- Meet requirements of the officers' needs

- Attract and develop officers

- Foster careers

- Provide flexibility

In addition, there are other factors that should be taken into account when developing a management system. These are:[4]

- Relative cost

- Uniformity among military services and skill groups

- Public confidence in the military as an institution

- Number of officers entering and leaving careers

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[3] Harry J. Thie et al., *Future Career Management Systems for U.S. Military Officers*, National Defense Research Institute Study, (Santa Monica, CA: The RAND Corporation, 1994), 8.

[4] Ibid, 9.

Current Army personnel practices are based on Officer Personnel Management System XXI and Warrant Officer Personnel Management System XXI. These practices are now called the Officer Personnel Management System (OPMS). The mission of the Army OPMS is to:[5]

- Enhance the war-fighting capability of the Army

- Provide all officers with a reasonable opportunity for success

- Fulfill Army requirements with an officer corps balanced with the right grades and skills

The OPMS is subject to continual revision and there is one important point that must be considered in making these improvements: Any new legislation should be based on how future officers will need to be managed to confront the dynamics of the future environment.[6]

1. Officer Personnel Management System[7]

The Officer Personnel Management System is implemented by the USA Human Resources Command (HRC) Officer Personnel Management Directorate (OPMD). The mission of OPMS is to:[8]

- Access and designate officers in the right numbers and with the right skills to satisfy current and projected Army requirements

- Develop the professional skills and warrior ethos of officers through planned schooling and sequential, progressive assignments

- Assign officers to meet Army requirements

- Separate officers to meet individual and Army needs

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[5] *Department of the Army Pamphlet 600-3, Commissioned Officer Development and Career Management,* (Washington, DC: Headquarters Department of the Army, 2005), 1, Army Publishing Directorate Web Page http://www.usapa.army.mil/pdffiles/p600_3.pdf, (Accessed March 2, 2006).

[6] Bernard Rostker, *The Defense Officer Personnel Management Act of 1980*, (Santa Monica, CA: The RAND Corporation, 1993), 70.

[7] *Department of the Army Pamphlet 600-3, Commissioned Officer Development and Career Management,* 3, 10, 11, 12.

[8] Ibid, 10.

"The purpose of OPMS is to enhance the effectiveness and professionalism of the officer corps."[9] It is an evolutionary system that is modified by external environmental factors, doctrine, dynamics of force structure, and leader development principles. It is reviewed annually according to the changing Army requirements. Law, policy, budget, proponent vision, officer needs, technology, specialization, and special programs are the factors that affect OPMS.

OPMS has several subsystems:

- Strength management

- Career development

- Evaluation

- Centralized selection

Strength management is a dynamic issue. The following factors determine the number of officers needed, their grades, and specialties: the Army's requirements; law; budget; and policy. The number of officers that will be accessed and the number of promotions, developments, assignments, and separations are all determined according to these factors, which can change at any time. Strength management deals with this changing environment. This is why strength management is so important.

Each branch, Functional Area (FA), or officer skill proponent defines what is required for an officer at each grade level. HRC develops each officer's career by using the life cycle development models that are based on the requirements.

There is a pyramidal structure in the Army. Only the officers with the best performance and potential are promoted. Therefore, officer evaluation is critical in OPMS. Officers' promotion, school selection, career field designation, command selection, retention, and career development opportunities are all based on information contained in the Officer Evaluation Reports.

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[7] *Department of the Army Pamphlet 600-3, Commissioned Officer Development and Career Management,* 3.

Selection boards advance officers to the next stage of career development. These boards look at evaluation reports, life cycle development models and strength requirements. Centralized selection ensures that only the best qualified individuals obtain positions that require the greatest responsibilities.

2. Career Management

The OPMS results in different alternative career patterns. The individual officer, the commander, the proponent, and the OPMD assignment manager have major influence on an officer's career management and career development. There is an interaction among these groups in order to find the best solution both for the officers and the Army.

The individuals are their own career managers. The Army dictates the final outcome of all career development actions. The individuals participate in the development process by volunteering for training and education programs, by their selection of Functional Area (FA), their choice of career field, applying for entry into special programs, and long-range planning of their career goals. All officers receive advice and career counseling from their raters, senior raters, and mentors. Proponents design life cycle development models and monitor the overall career development of officer populations. The OPMD assignment managers meet the career development needs of various branches, FAs, and career fields. They also look at Army requirements.

Officer ranks range from O-1 to O-10. Ranks in the Army are as follows:[10]

- O-1 (2nd Lieutenant)

- O-2 (1st Lieutenant)

- O-3 (Captain)

- O-4 (Major)

- O-5 (Lieutenant Colonel)

- O-6 (Colonel)

- O-7 (Brigadier General)

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[10] Bernard Rostker, *The Defense Officer Personnel Management Act of 1980,* (Santa Monica, CA: The RAND Corporation, 1993), 8.

- O-8 (Major General)

- O-9 (Lieutenant General)

- O-10 (General)

All O-1s are promoted to O-2 in the first or second year of their service if they are qualified. Promotion to O-3 is around the fourth year of service. Before promotion to O-4, officers spend between five to seven years in the rank of O-3 in the Army. Promotion is more difficult beyond O-3. The target promotion rate from O-3 to O-4 is 80 percent. Promotion to O-5 takes between 15 and 17 years, with a promotion rate of 70 percent. Officers spend about five years in grade O-5. Promotion to O-6 normally occurs between years 21 and 23. About 50 percent of the officers are promoted to O-6. Officers spend about five years in grade O-6. The selection rate to O-7 and above is less than 10 percent.[11]

B.   OFFICER CAREER DEVELOPMENT[12]

The current officer development model is designed to develop a joint and expeditionary professional officer corps. The model highlights the importance of a joint, interagency, intergovernmental, and multinational educational developmental zone. It tries to build multi-functionality in field grade officers and develop the skills required by the combatant officers. The officers will acquire different skills and experience as they serve on different assignments. They should be highly experienced by the time they reach senior executive levels of the officer corps.

There are four phases of officer development which are company grade development, major development, lieutenant colonel development and colonel development phases, respectively.

[11] Beth J. Asch, *A Theory of Military Compensation and Personnel Policy*, (Santa Monica, CA: The RAND Corporation, 1994), 7, 8.

[12] *Department of the Army Pamphlet 600-3, Commissioned Officer Development and Career Management*, 12 –22.

1. Company Grade Development

Company Grade Development begins with active duty and ends in the 12th year of service. There are two basic parts to development: Branch Specific Development and Post-initial Branch Development.

a. *Branch Specific Development*

This part of development begins with active duty and lasts through the 10th year. The development process commences with the Officer Basic Course (OBC), which is now called Basic Officer Leader Course (BOLC). During Branch Specific Development, the officers encounter the following events:

- Basic Education—Basic Education includes BOLC II and BOLC III. BOLC II is the beginning of a company grade officer's formal military professional development after his or her commission. BOLC III is a course that prepares officers for their first duty assignment.

- Initial Assignments—After graduating from BOLC III, a majority of officers are assigned to a branch duty position.

- Captains Officer Education System—Captains Officer Education System is under review now. The training will take fewer than six months and it will cover company command, staff competencies, branch and combined arms focus, introduction to joint operations, digital skills, and knowledge- and application-based instruction.

- Captains Career Course—Captains Career Course (CCC) is the current formal education process for Captains (CPT) in the Army. Officers attend CCC after promotion to Captain. Selected CPTs may receive this course at schools other than their basic branch school.

- Branch Opportunities—All company grade officers must master the basic skills of their specific branch. At this stage, ability and skills to command a unit are very important for an officer. Officers with a potential and desire to command soldiers fill command positions.

b. *Post-initial Branch Development*

Between the 8th and 12th years of service, other options are available for career development. The types of assignments and developmental patterns are:

- Branch Assignments—These may include staff and faculty positions at service schools, Combat Training Center duty, or staff positions in tactical or training units.

- Branch/Functional Area Generalist Assignments—These assignments may be performed by officers with certain types of experience, performance, and potential. U.S. Army Recruiting Command (USAREC) staff and command positions, Reserve Officer Training Corps (ROTC), United States Military Academy (USMA) faculty and staff, and Major Army Command (MACOM) staff positions are examples of these assignments.

- Functional Area Development—Some company grade officers attend specialized courses for functional area development.

- Advanced Civil Schooling—Each year approximately 450 officers obtain graduate-level degrees from civilian academic institutions. The degrees take between 12 and 22 months to complete.

- Training with Industry—Each year between 50 and 70 officers are assigned to train within civilian industry. They observe the technical and managerial aspects of a specific field in civilian industry.

- Army Acquisition Corps—About 150 Captains are developed in this Functional Area between their 7th and 8th year of service.

- Early Career Field Designation—Some FAs require lengthy education and training. Therefore, these officers enter the career field early. (This does not affect the promotion potential to Major.)

- Selection for Promotion to Major—An officer is considered for Major after the 10th year of service. The objective selection rate is 80 %.

2. Major Development

The Major Development phase begins with the selection to Major (MAJ). It occurs between the 12th and 17th years of service and is a critical period in an officer's career. During the junior field grade years, officers serve in different branches or FA assignments. The general development goals in this phase should be completed within 10 months of Intermediate Level Education (ILE) military level 4 (MEL 4) training and to meet other basic branch or FA qualification criteria.

Majors in the Operational Support, Institutional Support, and Information Operations career fields who don't have FA experience begin their FA professional development phase. For officers who are designated into FAs, training and education is focused on their areas of specialization.

Officers are considered for Lieutenant Colonel (LTC) in their 16th year of service. About 70 % of the Majors become Lieutenant Colonels.

3. Lieutenant Colonel Development

The Lieutenant Colonel Development phase starts in the 17th year of service and ends in the 22nd year of service. The senior field grade years begin during these years. Lieutenant Colonels (LTCs) make the maximum contribution to the Army as commanders and senior staff officers. They provide wisdom, experience, vision, and mentorship. The career development goals are to gain branch, FA, and skill proficiency through assignments and schooling.

The Lieutenant Colonels serve in branch, FA, joint duty, and branch/FA generalist assignments. A limited number of officers are selected for command. The LTC Command Selection List has the following categories:

- 1st Category—This category consists of tactical units at divisional, Corps, and echelons above Corps levels, together with Major Army Command (MACOM) assets directly involved in combat operations.

- 2nd Category—This category is training and strategic support. It includes MACOM assets that are not directly involved in combat operations.

- 3rd Category—This category is institutional. It includes garrison and U.S. Army Recruiting (USAREC) commands.

In the LTC Development phase, approximately two of five eligible officers command battalions. The command tours of LTCs generally occur during the 18th through 20th years of service.

The Senior Service College (SSC) selection board reviews the files of the officers after the 16th year of service. The SSC prepares officers for the positions that require great responsibility and is the final major military educational program. Officers attend SSC between the 16th and 23rd years of service. About 350 officers attend SSC every year. After graduating from SSC, officers serve in the Army Staff (ARSTAF), Joint Chiefs of Staff (JCS), Secretary of Defense (SECDEF), MACOM, and combatant command staffs in branch, FA, branch/FA generalist, or Joint coded positions.

LTCs are considered for promotion to Colonel (COL) in their 21st year of service. About 50 % of the LTCs promote to COL.

4. Colonel Development

The officers selected for promotion to Colonel continue their senior field grade phase. There are three options for them: separation from active duty, retirement, and selection for promotion to Brigadier General (BG). COLs contribute to the Army as commanders and senior staff officers. The general career development goals are to further enhance branch or FA skill proficiency. COLs reach these goals through senior level assignments and schooling. COLs in the Operations career field serve in high-level staff positions.

Colonels serve in branch, FA, and Joint duty assignments in the Colonel Development phase. The SSC selection board reviews the files of COLs until the 23rd year of service. Some of the COLs in the Operations career field are selected for command The COL command selection continues until the 26th year of service. The opportunity to serve in command positions varies by branch; between 16% and 50 % serve in command positions. However, the majority of officers serve as branch or FA senior staff rather than serving in command positions.

C. CAREER BRANCHES, FUNCTIONAL AREAS, AND LIFE CYCLE DEVELOPMENTS[13]

Branch or FA designation occurs immediately after selection to MAJ. The designation is determined by a Headquarters, Department of the Army (HQDA) centralized selection board. The board designates the officer into a branch or FA in one of four career fields: operations, information operations, institutional support, and operation support. In the designation process, the officer's preference, rater and senior rater input, experience, qualifications, and Army requirements are taken into account.

1. Career Branches

"A branch is a grouping of officers that comprises an arm or service of the Army in which, as a minimum, officers are commissioned, assigned, developed, and promoted through their company grade years."[14] Officers are accessed into a single basic branch and hold that branch designation. In the first 8 to 12 years of service, officers develop the leadership and tactical skills associated with their branch. "All career branches are in the Operations career field." [15]

The branch categories in the Army are:[16]

- Combat Arms Branches

  o Infantry

  o Armor

  o Field Artillery

  o Air Defense Artillery

  o Aviation

  o Special Forces

  o Corps of Engineers

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[13] *Department of the Army Pamphlet 600-3, Commissioned Officer Development and Career Management*, 52 and 53.

[14] *Department of the Army Pamphlet 600-3, Commissioned Officer Development and Career Management*, 52.

[15] Ibid.

[16] Ibid, 52, 53.

- Combat Support Branches

  - Signal Corps

  - Military Police Corps

  - Military Intelligence Corps

  - Civil Affairs

  - Chemical Corps

- Combat Service Support Branches

  - Adjutant General Corps

  - Finance Corps

  - Transportation Corps

  - Ordnance Corps

  - Quartermaster Corps

- Special Branches

  - The Judge Advocate General's Corps

  - Chaplain Corps

  - Medical Corps

  - Dental Corps

  - Veterinary Corps

  - Army Medical Specialists

  - Army Nurse corps

  - Medical Service Corps

2. Functional Areas

"An FA is a grouping of officers by technical specialty or skill, which usually requires significant education, training, and experience."[17] Officers receive their FAs when they are company grade officers. After completing the branch development requirements, officers may serve in an FA assignment during their company grade years. The FAs in the Army are:[18]

- Psychological Operations

- Civil Affairs

- Multifunctional Logistician Program

- Human Resource Management

- Comptroller

- Academy Professor, U.S. Military Academy

- Operations Research/Systems Analysis

- Force Management

- Nuclear Research and Operations

- Strategic Plans and Policy

- Telecommunications Systems Engineering

- Information Operations

- Strategic Intelligence

- Space Operations

- Public Affairs

- Information Systems Management

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[17] *Department of the Army Pamphlet 600-3, Commissioned Officer Development and Career Management*, 53.

[18] Ibid.

- Simulations Operations

- Foreign Area Officer

- Army Acquisition Corps

3.   Officer Life Cycle Developments

This section describes the life cycle developments of the Combat Arms, Combat Support, Combat Service Support, and Special Career Branch Categories. Because there are many career branches, figures that show the life cycle development and utilization of infantry, armor, field artillery, aviation, special forces, corps of engineers, military intelligence corps, adjutant general corps, and the Judge Advocate General's corps are included.

Figures 1-9 below consists of six parts. The first part shows the length of service for the commissioned officer. The length of the service is between zero and 30 years in all of the figures. The second part is about the ranks. It shows the possible promotion times for the officers in their careers. The third part describes the professional military education the officers get in each rank. Information about the additional training for the officers can be found in the fourth part. The fifth part shows the typical assignments the commissioned officers have in every rank and the last part is about the self development opportunities of the officers.

a. Infantry

Figure 1. Infantry Officer Life Cycle Development and Utilization (From: Department of the Army Pamphlet 600-3, Commissioned Officer Development and Career Management, (Washington, DC: Headquarters Department of the Army, 2005), 63) Army Publishing Directorate Web Page http://www.usapa.army.mil/pdffiles/p600_3.pdf, (Accessed July 6, 2006).).

b. Armor

| YEARS | 0 | | 10 | | 20 | | 30 |

Rank: LT · CPT · MAJ · LTC · COL (with FAP, CFD)

Professional Military Education: OBC/BOLC · CCC · ILE · SSC

Specialty Training: Air Assault / Airborne / Ranger; Scout / Cavalry Leader; BMOC/Mortar Plt; M1A2 Tank/Bradley/Stryker Commander; Pre-Command Course

DEVELOPMENTAL & UTILIZATION ASSIGNMENTS

Typical Assignments:

LT	CPT	MAJ	LTC	COL
Platoon Leader	Company/Troop Command	Battalion/Squadron S3/XO	Battalion/Squadron Command	Brigade Command
Specialty Platoon Leader	Battalion/Brigade Staff	Joint Assignment	Joint Assignment	Joint Assignment
Company XO	CTC Observer Controller	Brigade S3/XO	Brigade DCO	Division/Corps Staff
Bn Staff	AC/RC OC/Team Chief/Staff	Division/Corps Staff	Brigade XO	DA/Joint Staff
Installation Staff	USAREC Company Commander/Staff	AC/RC OC/Staff	Division/Corps Staff	MACOM Staff
	ROTC APMS	Doctrine/Training Developer	CTC	
	Service School Instructor/SGI	DA Staff	AC/RC Commander, OC, Staff	
	Doctrine/Training Developer	CTC Trainer	ROTC PMS	
	USMA Faculty and Staff	MACOM Staff		
		ROTC APMS		
		USMA Faculty and Staff		

Self Development: Baccalaureate Degree · Graduate Degree · CSA Professional Reading / Self-Development · Reading/formal training to expand tactical and technical proficiency, leadership skills and intellectual capital

Figure 2.   Armor Officer Life Cycle Development and Utilization (From: Department of the Army Pamphlet 600-3, Commissioned Officer Development and Career Management, (Washington, DC: Headquarters Department of the Army, 2005), 72) Army Publishing Directorate Web Page http://www.usapa.army.mil/pdffiles/p600_3.pdf, (Accessed July 6, 2006).).

c. ***Field Artillery***

Years of Service	0	GOAL 36 months in branch developmental assignments		10	GOAL 36 months in branch developmental assignments		20		30

Rank

LT	CPT	MAJ	LTC	COL
	Functional Area Decision · Career Field Decision OPCF➡			

PME

OBC BOLC*	Captains Career Course	ILE**	SSC***

Professional Military Education   *BOLC = Basic Officer Leader Course   **ILE = Intermediate Level Education   *** SSC = Senior Service College

Additional Training

Airborne   Assignment Oriented Training (BFIST / MLRS / Information OPS / etc)   Other Senior Service Schools
Ranger   Joint Operations Training   Joint Targeting   Exchange Programs
Air Assault   Special Skills & Duty Training   Numerous Other Special Courses and Schools

Typical Field Artillery Developmental Assignments

- Firing Btry Platoon Leader - Company Fire Support Officer (FSO) - Plt/Btry Fire Direction Officer - Battery Ops Off - Battery XO - Recon Officer - Bn Ammo Off - Radar Plt Ldr - Bn LNO - Staff Officer	- *Battery Commander (12-36 months) - *Battalion Fires Officer (Maneuver/Special Ops) (includes Bn FSO) - Other Fires & Effects Officers - CTC Observer/Controller - School SGL/Instructor - Battalion Fire Direction Officer - Battalion Assistant S3 - Battalion/Brigade/Division Artillery Operations Staff - Primary Staff Officer - (USMA/ROTC/Branch) - Other Nominative Assignments/Joint - ROTC/AC/RC/Staff HQs - Recruiting Command	- *FA Battalion S3 / XO - *Brigade Fires & Effects Coordinator/ECOORD/FSO - *BDE Level S3 / XO - SGL or O/CE (CTCs) - Other Fires & Effects Officer (BDE/DIV/UEx/UEy/BCD) - Staff (Division/Corps/EAC) - Assistant Fire Support Coordinator - Brigade Primary Staff - Corps Arty Assistant G3 - Operations Off (Fires & Effects Cell/BCD/FAIO) - Nominative Assignments (ROTC / USMA / etc) - Joint, Interagency, MultiNatl Army Level HQs /Staff - Exchange Officer Programs	- *Battalion Commander (24-36 months) - *FA Brigade/Division Artillery S3 or XO - Joint, Interagency, MultinationalStaff - Fires & Effects Coordinator (UEx/UEy) - FSCOORD/ECOORD - Division Deputy Fire Support Coordinator - Corps/UEx/y Fires & Effects Elements - Fires Bde ECOORD - CTC Senior Observer Controller - ROTC/AC/RC/USAREC - Special Assignments - Other Assignments	- Brigade Level Commander (24-36 months) - Senior Fires & Effects Coordinator - Deputy Cdr/CofS - Joint/Army Staff, Interagency, Multinational, Coalition Staffs - Commander, Battlefield Coordination Detachment - IET BDE CDR - TRADOC Systems Manager - Other Assignments

Self Development

Baccalaureate Degree	Graduate Degrees – Masters & Advanced Civil Schooling Options (competitive)

Figure 3.   Field Artillery Officer Life Cycle Development and Utilization (From: Department of the Army Pamphlet 600-3, Commissioned Officer Development and Career Management, (Washington, DC: Headquarters Department of the Army, 2005), 91) Army Publishing Directorate Web Page http://www.usapa.army.mil/pdffiles/p600_3.pdf, (Accessed July 7, 2006).).

d.   *Aviation*
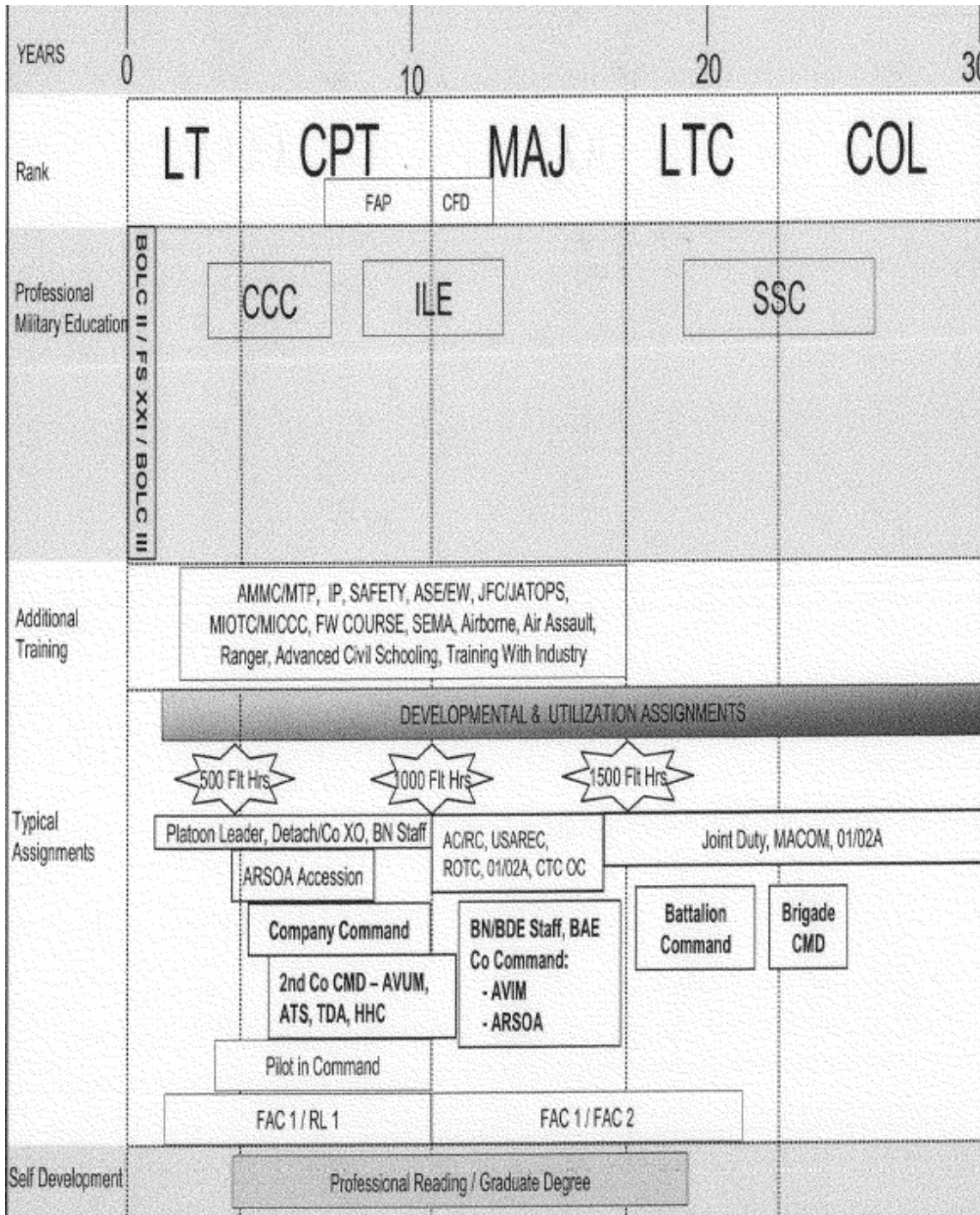
Figure 4.   Aviation Officer Life Cycle Development and Utilization (From: Department of the Army Pamphlet 600-3, Commissioned Officer Development and Career Management, (Washington, DC: Headquarters Department of the Army, 2005), 116) Army Publishing Directorate Web Page http://www.usapa.army.mil/pdffiles/p600_3.pdf, (Accessed July 7, 2006).).

e.   ***Special Forces***

YEARS	0	10	20	3
Rank	LT	CPT (FAP / CFD)	MAJ	LTC	COL
Professional Military Education	OBC/BOLC	SFAS, ABN, CCC, SFQC	ILE		SSC
Additional Training		Ranger, Jumpmaster, SF Advanced Skills			

DEVELOPMENTAL & UTILIZATION ASSIGNMENTS

Typical Assignments				
Typical Basic Branch Assignments: Platoon Leader Detach/Co XO Bn Staff, etc	SFODA Cdr, SF Company XO, HSC/HHC Cdr, Bn/Group Staff, JFKSWCS Cadre/Faculty, CTC Observer/Controller, Special Mission Unit, ROTC/USMA Faculty, Joint Staff or OSD Intern, Functional Area	SF Company Cdr, XO/S3, SF BN/Group, Special Mission Unit, TSOC Staff, JSOTF/JTF Staff, CTC Observer/Controller, USASOC/USASFC Staff, JFKSWCS Cadre/Faculty, DA/Joint Staff, ROTC/USMA Faculty	CSL Bn-level Command, SF Group DCO/XO, Special Mission Unit, TSOC Staff, JSOTF/JTF Staff, CTC Observer/Controller, USASOC/USASFC/ JFKSWCS Staff, DA/Joint Staff, Interagency Staffs, ROTC/USMA Faculty	CSL Group/Bde-level Command, Special Mission Unit, TSOC Staff, JSOTF/JTF Staff, USASOC/USASFC/ JFKSWCS Staff, DA/Joint Staff, Interagency Staffs, ROTC/USMA Faculty

Self Development	
Baccalaureate Degree	Graduate Degree; Enhance Foreign Language Skills and Regional Orientation

Figure 5.   Special Forces Officer Life Cycle Development and Utilization (From: Department of the Army Pamphlet 600-3, Commissioned Officer Development and Career Management, (Washington, DC: Headquarters Department of the Army, 2005), 141) Army Publishing Directorate Web Page http://www.usapa.army.mil/pdffiles/p600_3.pdf, (Accessed July 7, 2006).).

f. **Corps of Engineers**
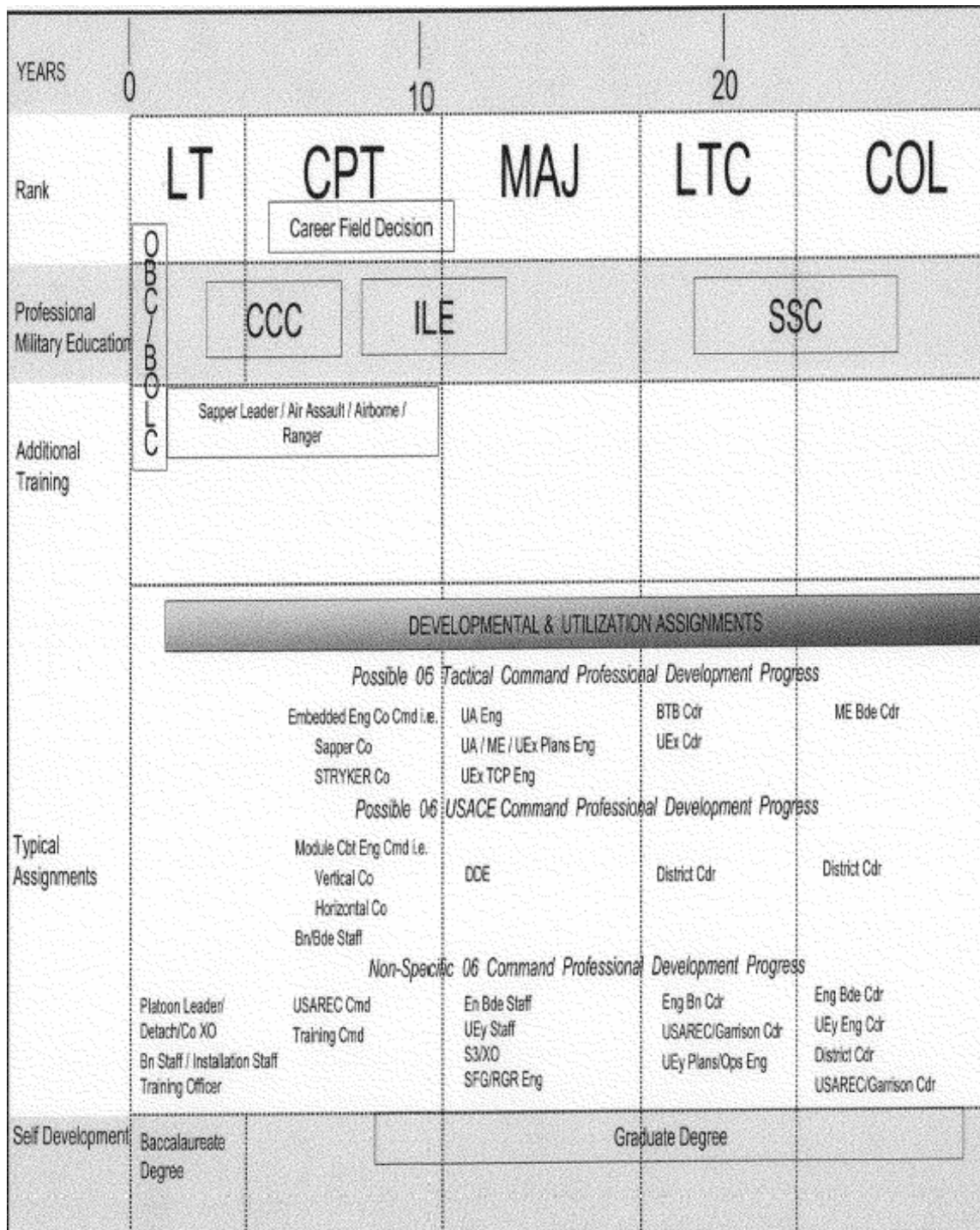
Figure 6.   Engineer Officer Life Cycle Development and Utilization (From: Department of the Army Pamphlet 600-3, Commissioned Officer Development and Career Management, (Washington, DC: Headquarters Department of the Army, 2005), 151) Army Publishing Directorate Web Page http://www.usapa.army.mil/pdffiles/p600_3.pdf, (Accessed July 8, 2006).).

g. Military Intelligence Corps
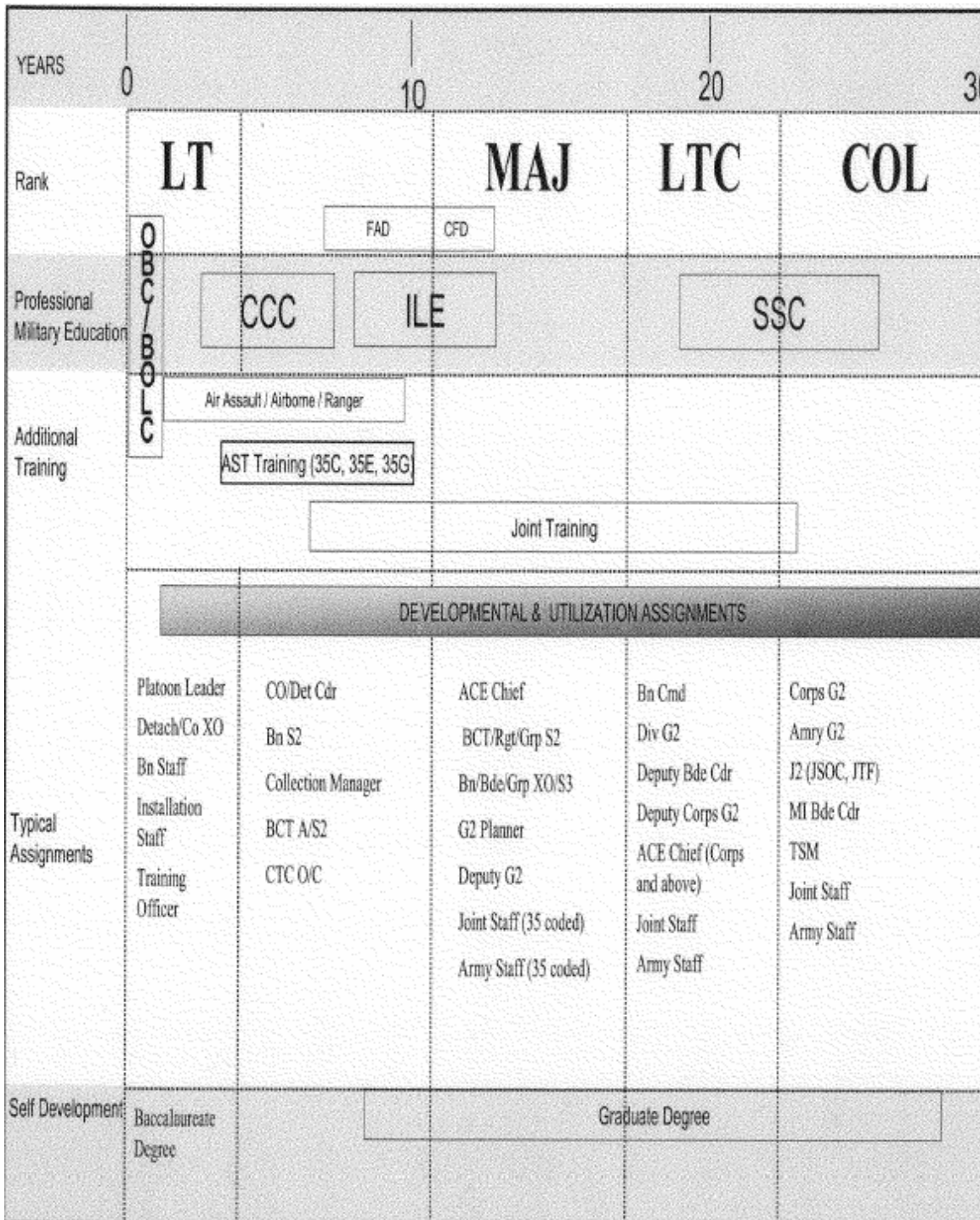
Figure 7. Military Intelligence Officer Life Cycle Development and Utilization (From: Department of the Army Pamphlet 600-3, Commissioned Officer Development and Career Management, (Washington, DC: Headquarters Department of the Army, 2005), 210) Army Publishing Directorate Web Page http://www.usapa.army.mil/pdffiles/p600_3.pdf, (Accessed July 8, 2006).).

h. *Adjutant General Corps*
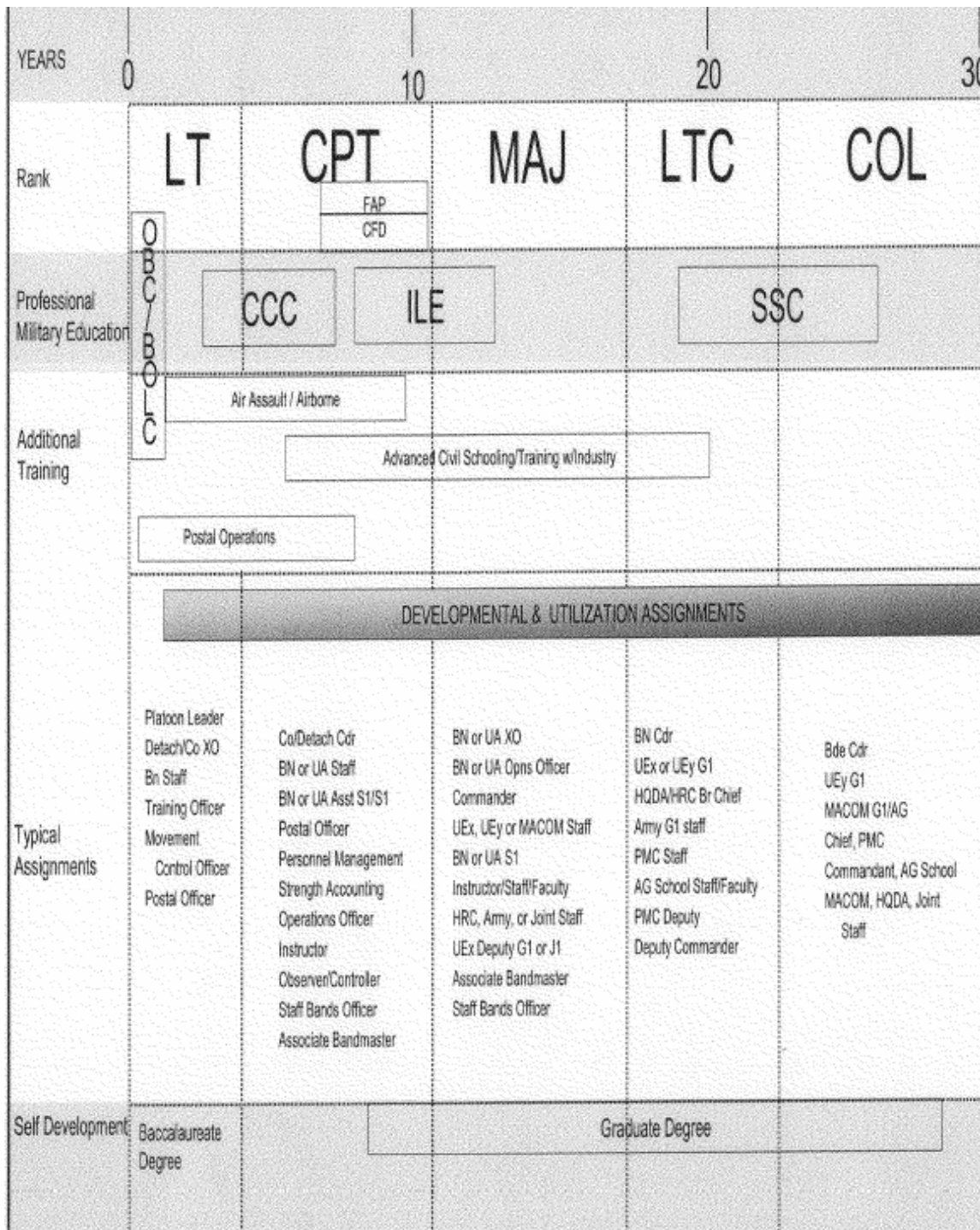
Figure 8.   Adjutant General Officer Life Cycle Development and Utilization (From: Department of the Army Pamphlet 600-3, Commissioned Officer Development and Career Management, (Washington, DC: Headquarters Department of the Army, 2005), 231) Army Publishing Directorate Web Page http://www.usapa.army.mil/pdffiles/p600_3.pdf, (Accessed July 8, 2006).).

i. ***The Judge Advocate General's Corps***

YEARS	0		6-7		12-14		18		3

Rank: LT | CPT | MAJ | LTC | COL

Professional Military Education: Law School Credit | OBC/BOLC | Grad Course | ILE | SSC

Additional Training: Air Assault / Airborne | Civilian LLM | Senior Mgmt. Training / Worldwide CLE

Continuing Legal Education

DEVELOPMENTAL & UTILIZATION ASSIGNMENTS

Typical Assignments:

Legal Assistance Attorney	Division Chief or DSJA at Division/UEx or Installation	Division Chief or DSJA at Corps/UEy or Instltn	SJA, Corps/UEy, MACOM or Installation
Trial Counsel	Litigation Attorney, USALSA	SJA, Division/UEx or Installation	Legal Advisor, Combatant Cmd or JCS
Trial Defense Counsel	OIC, Europe	Dpty Legal Advisor, Combatant Command	Trial or Appellate Military Judge
Administrative Law Attorney	Action Officer, Combatant Cmd or OTJAG	Branch Chief, OTJAG	Division Chief, OTJAG
Operational Law Attorney	Specialization Assignment	Military Trial Judge	Specialization Assignment
Claims Attorney	Professor/Staff, TJAGLCS	Specialization Assignmt	
Brigade Combat Team JA	Brigade Combat Team JA		

Self Development: Military History, Legal Research, Writing & Publication
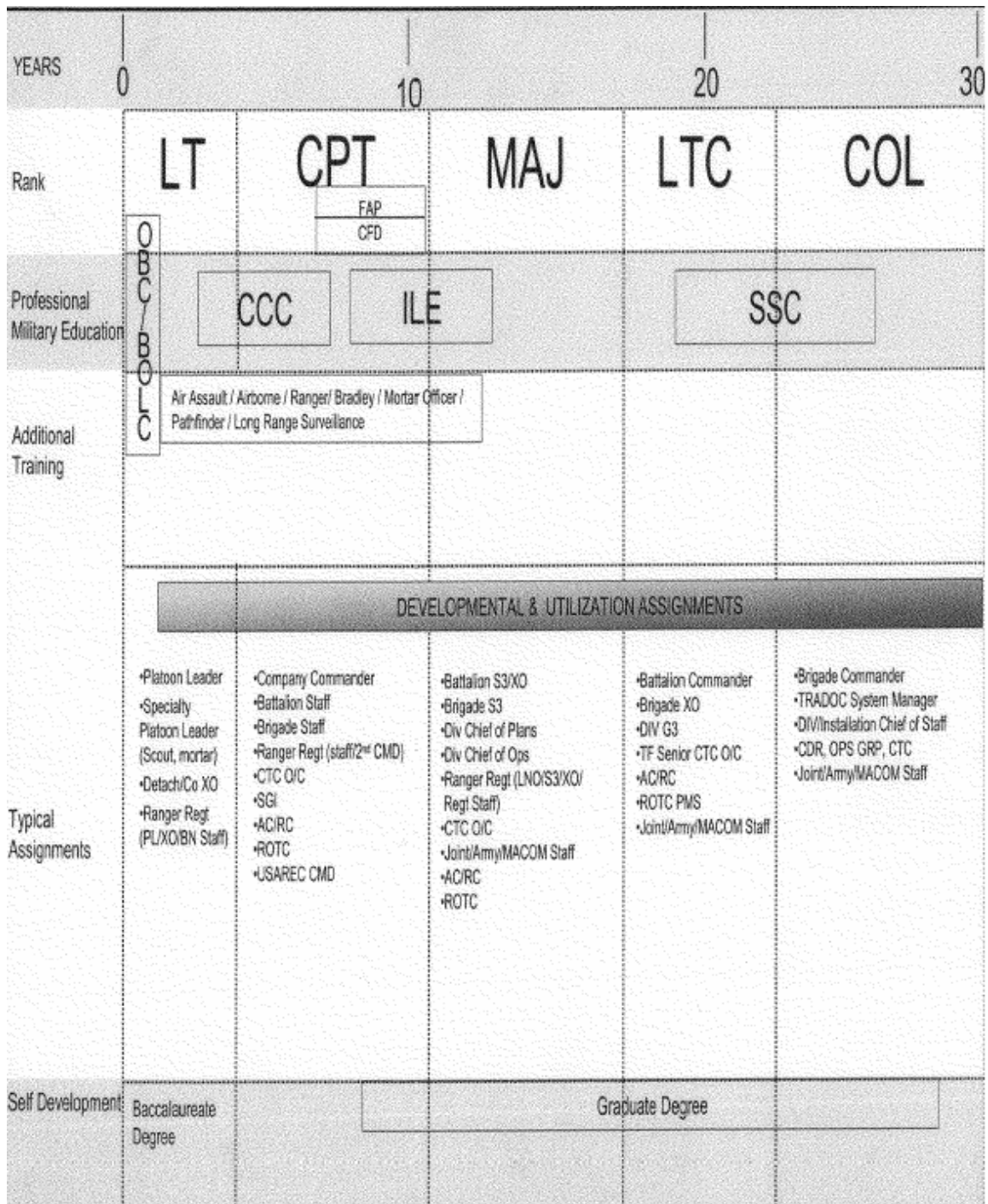
Figure 9.   The Judge Advocate General's Corps Officer Life Cycle Development and Utilization (From: Department of the Army Pamphlet 600-3, Commissioned Officer Development and Career Management, (Washington, DC: Headquarters Department of the Army, 2005), 479) Army Publishing Directorate Web Page http://www.usapa.army.mil/pdffiles/p600_3.pdf, (Accessed July 9, 2006).).

D.   OFFICER CAREER FIELDS

The following are the four career fields in the Army:

- Operations Career Field

- Institutional Support Career Field

- Information Operations Career Field

- Operational Support Career Field

1.   Operations Career Field[19]

The Operations Career Field (OPCF) is comprised of officers who are experts in maneuver, maneuver support, and maneuver sustainment. These officers are trained, educated, and experienced in combined arms operations. They achieve directed objectives at the tactical, operational, and strategic levels of war. The OPCF provides the majority of opportunities to command units on the Command Selection List.

The OPCF encompasses the following career branches and FAs:[20]

- Infantry

- Armor

- Field Artillery

- Air Defense Artillery

- Aviation

- Special Forces

- Corps of Engineers

- Signal Corps

- Military Police Corps

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[19] *Department of the Army Pamphlet 600-3, Commissioned Officer Development and Career Management*, 54–57.

[20] Ibid.

- Military Intelligence Corps

- Civil Affairs

- Chemical Corps

- Adjutant General Corps

- Finance Corps

- Transportation Corps

- Ordnance Corps

- Quartermaster Corps

- The Judge Advocate General's Corps

- Chaplain Corps

- Medical Corps

- Dental Corps

- Veterinary Corps

- Army Medical Specialists

- Army Nurse Corps

- Medical Service Corps

- Psychological Operations

- Civil Affairs

- Multifunctional Logistician Program

OPCF has many assignment opportunities. All officers gain basic branch skills, knowledge, and attributes during their company grade years. They also develop their leadership skills during this period. "The goal of the professional development of OPCF field grade officers is to produce high performing leaders with operational and strategic leadership skills while sustaining highly qualified tactically and operationally oriented

officers to lead their respective branches/FAs in combat and on other assigned missions."[21] OPCF officers serve in both officer generalist and combat arms generalist assignments. Field grade officers serve in joint organizations worldwide. Joint experience is very important for OPCF officers. Starting in 2007, officers may not be appointed to the grade of Brigadier General (BG) unless they are Joint Specialty Officers (JSO).

2. Institutional Support Career Field[22]

The Institutional Support Career Field (ISCF) is comprised of seven FAs:[23]

- Human Resource Management

- Comptroller

- Academy Professor, U.S. Military Academy

- Operations Research & Systems Analyst

- Force Management

- Nuclear Research & Operations

- Strategic Plans & Policy

Officers in this career field are responsible for the acquisition and management of human resources or for financial management. Alternatively, they may serve as professors at the U.S. Military Academy, work in quantitative analysis and modeling, conduct doctrine development, provide technical advice and policy recommendations on weapons of mass destruction, or formulate regional, military, and national strategy and policy. ISCF officers do not have command opportunity, which is why they excel in their FA and serve in positions that support senior level decision makers within and outside the DOD.

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[21] *Department of the Army Pamphlet 600-3, Commissioned Officer Development and Career Management*, 57.

[22] *Department of the Army Pamphlet 600-3, Commissioned Officer Development and Career Management*, 339-341.

[23] Ibid, 339.

3.   Information Operations Career Field[24]

The Information Operations Career Field (IOCF) is comprised of seven FAs:

- Telecommunication Systems Engineering

- Information Operations

- Strategic Intelligence

- Space Operations

- Public Affairs

- Information Systems Management

- Simulations Operations

IOCF officers are highly trained and skilled in the techniques of information operations. They provide support to Army and Department of Defense (DoD) decision makers. They provide commanders with a specialized capability for planning, developing, and integrating information operations to support military operations at all levels of war. They design and develop telecommunications networks; plan and integrate offensive and defensive information operations; develop intelligence; develop space estimates and analysis and conduct space operations; develop and execute information strategies; plan, manage, and maintain computer networks and information technology resources; conduct training, exercises, mission planning, and mission rehearsals with simulations; develop future simulations; and integrate simulations with battle command systems.[25]

IOCF officers do not have command opportunity. They are eligible for officer generalist positions.

4.   Operational Support Career Field[26]

The Operational Support Career Field (OSCF) is comprised of two FAs:

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[24] *Department of the Army Pamphlet 600-3, Commissioned Officer Development and Career Management*, 397, 398.

[25] *Department of the Army Pamphlet 600-3, Commissioned Officer Development and Career Management*, 397.

[26] Ibid, 451.

- Foreign Area Officer

- Army Acquisition Corps

Officers in OSCF work almost exclusively at the strategic level. They generally support operational leadership. They serve in positions of increasing responsibility with distinct and FA-specific development objectives. They have experience and knowledge in political–military operations and regional expertise. They increase the effectiveness of the Army when interacting with foreign armed forces, foreign governments, and nongovernmental organizations (NGOs). They also develop, integrate, acquire, and field the systems that are critical for victory.

Each FA within OSCF has its own career development pattern. They may serve in officer generalist assignments prior to consideration for Colonel. They may also serve as Defense attachés, security assistance officers, arms control specialists, or staff officers. These are all joint assignments.

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III.   COMMISSIONING SOURCES OF ARMY OFFICERS

The Army is composed of Active Duty and Army Reserve units. Seventy-two percent of the Army consists of Active Duty personnel and 28 percent consists of Army Reserve personnel.[27] Enlisted soldiers, Non-Commissioned Officers (NCOs), Warrant Officers, and Commissioned Officers serve in both components. Enlisted soldiers, NCOs, Commissioned Officers, and Warrant Officers make up 83%, 15%, and 2 % of the Army, respectively.[28] Because this thesis concerns Commissioned Officers, this chapter describes the commissioning sources of Army officers. There are four main ways to become a Commissioned Officer in the U.S. Army:[29]

- United States Military Academy (USMA)

- Reserve Officers' Training Corps (ROTC)

- Officer Candidate School (OCS)

- Direct Commission

Apart from these major accession sources, each service has unique enlisted-to-officer commissioning programs. These programs are developed according to the needs and varied circumstances of enlisted personnel. The Air Force has the most options available. The number of service-specific options for Marine Corps and Navy commissioning are smaller than for the Air Force. However, the Army has a single program for enlisted personnel. This program is called the "Green-to Gold Program."[30] Enlisted service members who have served at least two years and are thought to have

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[27] The U.S. Army Webpage, "About the Army," http://www.goarmy.com/about/personnel.jsp, (Accessed July 9, 2006).

[28] Ibid.

[29] Michael R. Thirtle, *Educational Benefits and Officer-Commissioning Opportunities Available to U.S. Military Service Members*, (Santa Monica, CA: The RAND Corporation, 2001), 11–19.

[30] Ibid, 31.

officer potential can apply to this program. These service members request discharge from active duty. Then, they enroll in ROTC. They earn a bachelor's degree and then they are commissioned.[31]

The Green-to-Gold Program is not considered as a commissioning source in this study because of data limitations. After deleting the observations with missing commissioning sources, it is not possible to determine whether the commissioning source is Green-to-Gold Program for the observations which are not from any of the commissioning sources above. There is no information about them in the data set since they are defined as "other than above".

Figure 10 shows the relative size of each source and how the distribution varies by service. As seen in the figure, different services rely upon different commissioning sources. The Army relies most heavily on ROTC. The percentages of Direct Appointment officers and USMA graduates are close to each other but they are both much smaller than that of ROTC graduates. OCS and other sources account for the smallest percentages of newly commissioned Army officers. The contributions from each commissioning source for the Navy are close to each other so the Navy has a more balanced program. The Air Force relies most heavily on ROTC. However the Marine Corps uses OCS most extensively.

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[31] Michael R. Thirtle, *Educational Benefits and Officer-Commissioning Opportunities,* 29.

70%

60%

50%

40%

30%

20%

10%

0%

Percentage of service accessions

Academy   ROTC   OCS/OTS   Direct Appt   Other

Accession source

■ Army
▫ Navy
▣ Marine Corps
▨ Air Force
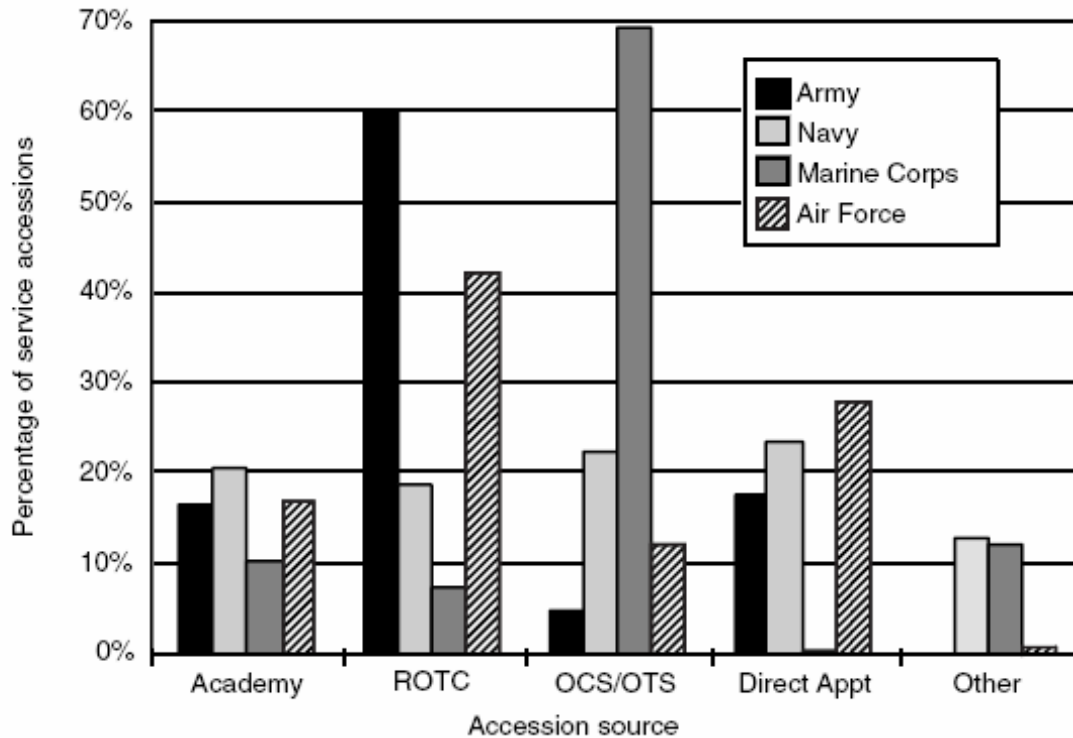
SOURCE: Office of the Assistant Secretary of Defense, *Population Representation in the Military Services, 1995*, 1996, Table 4.3; *Population Representation in the Military Services, 1997*, 1998, Table 4.3.

Figure 10.   Sources of Commission for Active-Duty Officers (FY97) (From Michael R. Thirtle, *Educational Benefits and Officer-Commissioning Opportunities Available to U.S. Military Service Members*, (Santa Monica, CA: The RAND Corporation, 2001), 23).

Figure 11 shows the relative size of each commissioning source over time. The changes from 1980 to 1997 in the percentages of officer accessions from each source for the Army, Navy, Marine Corps and Air Force are seen in this figure. For all of the services, the shares of the Academies, ROTC and Direct Appointments have increased over time whereas the opposite is true for other sources. The share of OTS/OCS decreased until 1989, and then it began to increase slightly. However, in 1997 the share of OTS/OCS is still below the share in 1980.

100% ─ Other
90% ─
80% ─
70% ─ Direct Appointment
60% ─
50% ─ OTS/OCS
40% ─
30% ─ ROTC
20% ─
10% ─
0% ─ Academy

Percentage of officer accessions

1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997

Fiscal year
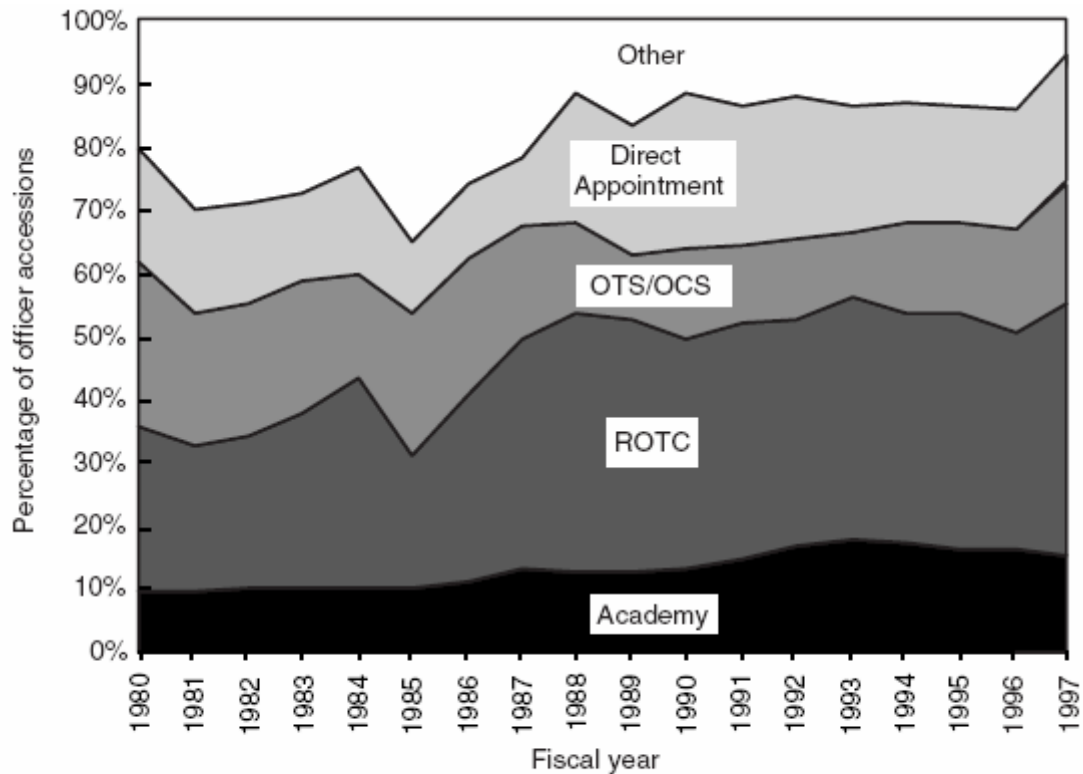
SOURCE: Defense Manpower Data Center, August 1997; for 1997, Office of the Assistant Secretary of Defense, *Population Representation in the Military Services*, *1997*, 1998.

Figure 11.   DoD Officer Accessions by Commissioning Source (FY80-FY97) (From Michael R. Thirtle, *Educational Benefits and Officer-Commissioning Opportunities Available to U.S. Military Service Members*, (Santa Monica, CA: The RAND Corporation, 2001), 22).

A.   UNITED STATES MILITARY ACADEMY

The United States Military Academy (USMA) was established in 1802.[32] At that time the United States needed many engineers, making civil engineering the foundation of the curriculum. USMA graduates were responsible for the construction of U.S.'s initial railway lines, bridges, harbors, and roads. USMA graduates gained experience and national recognition during the Mexican and Indian Wars. In the Civil War they dominated the highest ranks on both sides. The USMA broadened its curriculum beyond civil engineering after the Civil War, and graduates distinguished themselves in World War I after some revisions were made in the curriculum because of the physical demands

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[32] The U.S. Military Academy Webpage, "A Brief History of the Academy," http://www.usma.edu/history.asp, (Accessed May 13, 2006).

of modern warfare. The USMA continued these revisions after World War II. The developments in science and technology, the need to understand other cultures, and the rising level of general education in the Army were the reasons for the revisions.

In 1964, the strength of the Corps of Cadets was increased from 2,529 to 4,417. The curricular structure of the USMA was changed to permit cadets to major in any one of more than a dozen fields.[33]

Today the Corps of Cadets comprises over 4,000 men and women. There are 32 cadet companies, which are grouped into battalions (four companies each), regiments (two battalions each), and the Corps (four regiments).[34]

The USMA mission is[35]:

> To educate, train, and inspire the Corps of Cadets so that each graduate is a commissioned leader of character committed to the values of Duty, Honor, Country, and prepared for a career of professional excellence and service to the Nation as an officer in the United States Army.

There are a number of basic requirements for each USMA candidate. Each candidate must:[36]

- be 17 but not yet 23 years of age

- be a U.S. citizen at time of enrollment (exception: foreign students nominated by agreement between the U.S. and another country)

- be unmarried

- not be pregnant or have a legal obligation to support a child or children

- have an above-average high school or college academic record

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[33] The U.S. Military Academy Webpage, "A Brief History of the Academy," http://www.usma.edu/history.asp, (Accessed May 13, 2006).

[34] The U.S. Military Academy Webpage, "United States Corps of Cadets," http://www.usma.edu/uscc/CorpsOfCdts/index.htm, (Accessed May 13, 2006).

[35] The U.S. Military Academy Webpage, "USMA Mission," http://www.usma.edu/mission.asp, (Accessed May 13, 2006).

[36] The U.S. Military Academy Webpage, "Admissions," http://admissions.usma.edu/prospectus/step_01.cfm, (Accessed May 13, 2006).

- show strong performance on the standardized American College Testing (ACT) Assessment Program Exam or the College Board Admissions Testing Program Scholastic Assessment Test (SAT)

- be in good physical and mental health

- pass a medical exam

- have above-average strength, endurance, and agility

- show adequate performance on the USMA Physical Aptitude Exam

During the four-year program, the USMA develops cadets in four critical areas: intellect, physical fitness, military knowledge, and morals-ethics—a four-year process called the "West Point Experience."[37]

Each cadet serves in the Corps of Cadets during his or her educational career at the Academy:[38]

- First Class (fourth year)—First Captain (or Corps commander), Regimental Commanders, Battalion Commanders, Company Commanders, and Platoon Leaders

- Second Class (third year)—Squad Leaders, who supervise the lower two classes of cadets

- Third Class (second year)—Team Leaders, who provide personal oversight of one or two Fourth Class (first year) cadets

- Fourth Class (first year)

The academic program consists of 31 courses. Each cadet receives a Bachelor of Science degree. The physical program includes both physical education classes and competitive athletics. The military program begins on the first day at the USMA and aims to teach basic military skills and leadership. The number of officers who graduate from

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[37] The U.S. Military Academy Webpage, "About the Academy," http://www.usma.edu/about.asp, (Accessed May 13, 2006).

[38] The U.S. Military Academy Webpage, "United States Corps of Cadets," http://www.usma.edu/uscc/CorpsOfCdts/index.htm, (Accessed May 13, 2006).

the USMA each year is 900. As seen in Figure 10, USMA is the second largest commissioning source for the Army. Nineteen percent of the commissioned officers in the data set used for this study are USMA graduates. Figure 11 shows that the share of the officers who graduate from academies has increased over time for the Army as well as for the other services.

USMA graduates receive a commission as a second lieutenant. After commissioning they serve a minimum of five years on active duty.[39]

B. RESERVE OFFICERS' TRAINING CORPS

Army Reserve Officers' Training Corps (ROTC) is part of a participating college's curriculum.[40] It is an elective curriculum for college students and taken with required college classes. After graduating from college, participants become officers (Second Lieutenants) in the Army.[41]

There are several requirements for attending ROTC. Each candidate must be:[42]

- accepted or enrolled in a participating college or university

- a U.S. citizen

- physically fit

Participants learn how to lead, motivate, and conduct missions in classes and field training.[43] They take most or all of the following courses, depending on when they enroll in Army ROTC:[44]

- Army ROTC Basic Course

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[39] The U.S. Military Academy Webpage, "A Brief History of the Academy," http://www.usma.edu/history.asp, (Accessed May 13, 2006).

[40] The U.S. Army Webpage, "Army ROTC," http://www.goarmy.com/rotc/index.jsp, (Accessed May 15, 2006).

[41] The U.S. Army Webpage, "About Army ROTC," http://www.goarmy.com/rotc/about_army_rotc.jsp, (Accessed May 15, 2006).

[42] The U.S. Army Webpage, "Commissioned Officer," http://www.goarmy.com/about/officer.jsp#commission, (Accessed May 15, 2006).

[43] The U.S. Army Webpage, "Army ROTC," http://www.goarmy.com/rotc/index.jsp, (Accessed May 15, 2006).

[44] The U.S. Army Webpage, "Training & Curriculum," http://www.goarmy.com/rotc/training_and_curriculum.jsp, (Accessed May 15, 2006).

- Leader's Training Course

- Army ROTC Advanced Course

- Leader Development and Assessment Course

The Army ROTC Basic Course takes place during the first two years of college. Students learn basic military skills and the fundamentals of leadership.[45]

The Leader's Training Course is a four-week course that takes place both in class and on the field. It is an accelerated version of the Army ROTC Basic Course. By completing this course, participants receive qualification for the Army ROTC Advanced Course.[46]

The Army ROTC Advanced Course takes place during the last two years of college. Participating students learn advanced military tactics and gain experience in team organization, planning, and decision-making. The prerequisite for this course is completing either the Army ROTC Basic Course or the Leader's Training Course.[47]

The Leader Development and Assessment Course is a four-week summer course. The purpose of this course is to evaluate and train all Army ROTC cadets.[48]

The participants who receive an Army ROTC scholarship or enter the Army ROTC Advanced Course must agree to serve fulltime in the Army for three years (four years for scholarship winners).[49]

After graduation, Army ROTC cadets earn the rank of Second Lieutenant. They have the opportunity to become officers in air defense artillery, armor, aviation, engineering, field artillery, infantry, chemicals, military intelligence, military police,

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[45] The U.S. Army Webpage, "Army ROTC Basic Course," http://www.goarmy.com/rotc/ar_basic_course.jsp, (Accessed May 15, 2006).

[46] The U.S. Army Webpage, "Leader's Training Course," http://www.goarmy.com/rotc/leaders_training.jsp, (Accessed May 15, 2006).

[47] The U.S. Army Webpage, "Army ROTC Advanced Course," http://www.goarmy.com/rotc/ar_advanced_course.jsp, (Accessed May 15, 2006).

[48] The U.S. Army Webpage, "Leader Development and Assessment Course," http://www.goarmy.com/rotc/leader_development.jsp, (Accessed May 15, 2006).

[49] The U.S. Army Webpage, "Your Commitment to the Army," http://www.goarmy.com/rotc/your_commitment.jsp, (Accessed May 15, 2006).

signals, finance, the medical corps, the nurse corps, ordnance, personnel systems management, quartermaster, and transportation.[50]

The Army ROTC offers scholarships, which are based on merit and grades. These scholarships are:[51]

- Two-, three-, and four-year scholarship options based on the time remaining to complete a degree

- Full-tuition scholarships

- Additional allowances to pay for books and fees

Army ROTC scholarships also provide monthly living allowances of $300, $350, $450, and $500 for the first, second, third, and fourth years, respectively.

More than 600 colleges and universities have ROTC programs. As seen above in Figure 10, ROTC is the largest source of commissioned officers for the Army. Figure 11 shows that the share of the officers who graduate from ROTCs has increased over time for all of the services. Fifty nine percent of the commissioned officers in the data set used for this study are ROTC graduates.

C. OFFICER CANDIDATE SCHOOL

Candidates for OCS must attend Basic Training, a nine-week course. After completion of Basic Training, candidates attend Officer Candidate School. The training in OCS takes place both in class and in the field. Candidates learn leadership development, military skills, and adventure training.[52]

There are several requirements for attending OCS. Each candidate must:[53]

- meet basic enlistment eligibility requirements

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[50] The U.S. Army Webpage, "Officer Careers & Specialties," http://www.goarmy.com/RotcViewCareers.do, (Accessed May 15, 2006).

[51] The U.S. Army Webpage, "Army ROTC Scholarships," http://www.goarmy.com/rotc/scholarships.jsp, (Accessed May 15, 2006).

[52] The U.S. Army Webpage, "Training & Curriculum," http://www.goarmy.com/ocs /training_and_curriculum.jsp, (Accessed May 17, 2006).

[53] The U.S. Army Webpage, "Eligibility," http://www.goarmy.com/ocs/applications_eligibility.jsp, (Accessed May 17, 2006).

- be at least 19 and not past the 29th birthday

- have a General Technical (GT) of 110 or higher

- have at least a 4-year degree from an accredited college or university with a minimum 2.0 GPA. Applicants enrolled as a college senior and projected to complete a degree within 365 days are eligible to apply.

- be a US Citizen

- pass a physical administered at a Military Entrance Processing Station (MEPS)

The Officer Candidate School is a 14-week course, consisting of three phases:[54]

- Phase 1—Candidates learn basic leadership skills. They face both physical and mental challenges.

- Phase 2—This phase includes an academic program with the same physical and mental challenges as Phase 1. The purpose is to develop and enhance the technical skills and overall knowledge the commissioned officers will need.

- Phase 3—Candidates are tested on leadership abilities and the ability to work as a team on a 15-day training mission.

After graduation, the applicants who apply for Active Army OCS serve for three years, while the applicants who apply for Army Reserve OCS serve for six years.[55]After graduation, candidates earn the rank of Second Lieutenant. They have the opportunity to serve in all of the branches that ROTC graduates can serve except for the nurse corps.

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[54] The U.S. Army Webpage, "Army Officer Candidate Course," http://www.goarmy.com/ocs/officer_course.jsp, (Accessed May 17, 2006).

[55] The U.S. Army Webpage, "Your Commitment to the Army," http://www.goarmy.com/ocs/your_commitment.jsp, (Accessed May 17, 2006)

The services have different means to commission enlisted personnel into the officer corps. OCS is one of these means. For some of the services, enlisted personnel are allowed to apply directly to the OCS and receive officer commissions.[56]

As seen in Figure 10, OCS is the smallest commissioning source for commissioned Army officers. Figure 11 shows that the shares of OTS/OCSs decreased until 1989, and then it began to increase a slightly when all of the services are taken into account. However, in 1997 the share was still below the share in 1980. Six percent of the commissioned officers in the data set used for this study are OCS graduates.

OCS is the most flexible commissioning source. Since it has a short program period, the services may easily increase or decrease officer production according to their needs using the OCS commissioning source.

D.   DIRECT COMMISSION OFFICER

Direct commissioning is designed to fill the vacancies that cannot be filled by other sources. Selection is based on the degree of proficiency and experience in a specific field.[57]

People who have professional degrees in medical, legal, and religious fields have the opportunity to receive direct commissions.[58] Professional branches of the Army such as the Judge Advocate General (JAG) Corps, the Army Chaplain Corps, and the Army Medical Corps have their own officer training program for direct commission.[59] Training time varies; however, it is generally between three and five weeks.[60] Direct commission officers generally have military history, Army leadership, and career-specific courses.[61]

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[56] Michael R. Thirtle, *Educational Benefits and Officer-Commissioning Opportunities Available to U.S. Military Service Members*, (Santa Monica, CA: The RAND Corporation, 2001), 12, 13.

[57] The U.S. Army Human Resources Command Webpage, "Direct Appointment," https://www.hrc.army.mil/site/Active/opdistappts/images/apptmtbook.pdf, (Accessed May 19, 2006).

[58] Michael R. Thirtle, *Educational Benefits and Officer-Commissioning Opportunities Available to U.S. Military Service Members*, 19.

[59] The U.S. Army Webpage, "Commissioned Officer," http://www.goarmy.com/about/officer.jsp#commission, (Accessed May 19, 2006).

[60] Michael R. Thirtle, *Educational Benefits and Officer-Commissioning Opportunities Available to U.S. Military Service Members*, 20.

[61] The U.S. Army Webpage, "Commissioned Officer," http://www.goarmy.com/about/officer.jsp#commission, (Accessed May 19, 2006).

Basic requirements for direct commissioning are:[62]

- passing an extensive physical examination

- having a GT score of 110

- attaining a score of 19 on the ACT or 850 on the SAT (for those who do not have a 4-year degree)

- not having reached the birthday of the maximum age indicated prior to appointment

- being a graduate of high school or a school of comparable level and meeting any additional requirements for specific officer branches[63]

- having a good moral character[64]

- possessing traits as potential leaders and having the ability to deal effectively with people[65]

As seen in Figure 10, the percentages of the Direct Appointment officers and USMA graduates are close to each other. However, they are substantially smaller than that of ROTC graduates. Figure 11 shows the share of the Direct Commission from 1980 through 1997 for all services. As seen in the figure, the share of Direct Commission increased after 1989. Sixteen percent of the commissioned officers in the data set used for this study are Direct Commission officers.

Table 1 shows the age limitations for Direct Commission Officers. As seen in the table, the minimum age is 18 and the maximum age is 55.

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[62] The U.S. Army Reserve Webpage, "Direct Appointment (Commission)," http://www.usarc.army.mil/88thRSC/resources/officer_mgt/officer_accessions/direct_appointment.asp, (Accessed May 19, 2006).

[63] The U.S. Army Reserve Webpage, "Army Regulation 135-100," http://www.army.mil/usapa/epubs/pdf/r135_100.pdf, (Accessed May 19, 2006).

[64] Ibid.

[65] Ibid.

Table 1.   Minimum and Maximum Age Limitations for Direct Commission Officers (From: Army Webpage, "Army Regulation 135-100," http://www.army.mil/usapa/epubs/pdf/r135_100.pdf, (Accessed May 19, 2006).

Minimum and maximum age limitations

Grade	Minimum age	Maximum age less than
Second Lieutenants, except Chaplain Candidates	18	28
Second Lieutenants—Chaplain Candidates	18	34
First Lieutenants—Chaplains	18	40
First Lieutenant	21	33
Captain		39
Major		48
Lieutenant Colonel		51
Colonel		55
Warrant Officer	18	46

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IV. LITERATURE REVIEW

A. OVERVIEW

This chapter reviews previous studies that evaluate the factors that influence officer retention, promotion, and career progression, especially the impact of commissioning source and military occupational group. Although these studies have provided many important insights, only those that are directly related to this study are summarized.

B. LITERATURE DISCUSSION

1. Thirtle (2001)

In his study *Educational Benefits and Officer-Commissioning Opportunities Available to U.S. Military Service Members*, Thirtle described the educational benefits and officer commissioning programs that are available to active-duty U.S. military. He investigated whether the commissioning sources which services rely heavily upon differ from one service to the other. He collected information from published directives and reports, interviews, historical information, RAND, and the Internet. He pointed out that there are four primary commissioning sources in the U.S. military:[66]

- The Federal Service Academies

- ROTC

- OCS

- Direct Appointment

Thirtle also discussed that enlisted personnel could receive officer commissions. However, the programs which allow enlisted service members to receive officer commissions vary from one service to another. The following paragraphs illustrate the main points in the study concerning commissioning sources.[67]

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[66] Michael R. Thirtle, *Educational Benefits and Officer-Commissioning Opportunities Available to U.S. Military Service Members*, (Santa Monica, CA: The RAND Corporation, 2001), 11 and 12.

[67] Ibid, xv, 13–15, 18–24, 29, 31.

Each military service, except for the Marine Corps, has its own academy. Naval Academy graduates have the opportunity to be commissioned in the Marine Corps. All Academy graduates are required to serve eight years of military service (at least five years on active duty; the remainder may be spent in the reserves). There are also academy preparatory schools that serve the purpose of preparing students for entrance to academies. The Army, Navy, Air Force, and Coast Guard have separate preparatory schools. The duration of the preparatory school program is 10 months and includes academics, physical fitness, and military customs and courtesies.

ROTC is the largest commissioning source for officers. More than 600 colleges and universities have ROTC programs that vary from two to four years. The participants receive a college education, take military courses, and receive military training. Some ROTC participants receive scholarships.

OCS participants are generally college graduates. A four-year college degree is required for the Army and the Air Force. However, the Navy and the Marine Corps sometimes do not require a Bachelor's degree. OCS programs are used for purposes such as preparing enlisted personnel to become commissioned officers or attracting candidates to fill shortages in specialty areas. The duration of the programs is roughly between ten and sixteen weeks for all services. Among the three commissioning sources, OCS is the most flexible. Because of the short program period, the services have the opportunity to increase or decrease officer production according to their needs.

Direct appointments are made for people who have professional degrees in the medical, legal, and religious fields, and enter service at higher ranks when compared to other sources. The duration of the program varies from three to five weeks. This program provides military orientation and indoctrination.

Among all of the commissioning sources, the Academies require the longest drill training and instruction time. Academy graduates have a five-year commitment to active duty, while other sources of commissioning require only four years' commitment because of the higher cost of education in the Academies. However, the total time of commitment is eight years for all commissioning sources.

In addition to these three sources of commissioning, each service has unique programs for enlisted service members. The Air Force has the greatest number of options for officer commissioning, while the Army has only one program. However, because of the limited number of participants in some of the officer commissioning programs, their impact on officer-corps accessions is not clear.

The following table summarizes Thirtle's findings about accession sources:

Table 2.   Comparison of Accession Sources (From Thirtle (2001)).

Category	ServiceAcademy	ROTC	OCS/OTS	Direct Appointment
Duration	4 years; full-time status	1–4 years, depending on scholarship; part-time status	10–16 weeks, full-time	3–5 weeks, full-time
Benefits	All educational expenses paid $600/month stipend Commission as an officer	Depend on scholarship type Commission as an officer	Paid training Commission as an officer	Paid training Commission as an officer
Service obligation	8 years total (at least 5 years' active duty)	8 years total (at least 4 years' active duty if scholarship; 2–3 years if nonscholarship)	8 years total (at least 4 years' active duty)	Depends on specific program
Rank upon graduation	Second Lieutenant/ Ensign (Navy)	Second Lieutenant/ Ensign (Navy)	Second Lieutenant/ Ensign (Navy)	Depends on occupational specialty, constructive credit computation; usually Second Lieutenant-Captain/ Ensign-Lieutenant (Navy)
Federal government cost per graduate	$340,000	$86,000	$32,000	Less than OCS/OTS

2.   Korkmaz (2005)

In his thesis *Analysis of the Survival Patterns of United States Naval Officers*, Korkmaz (2005) identified the effects of commissioning sources on the longevity of U.S. Naval officers. He identified the following U.S. Navy commissioning sources:

- United States Naval Academy (USNA)

- The Reserve Officer Training Corps (ROTC)

- Officer Candidate Schools (OCS)

- Direct Appointment

- Enlisted Commissioning Program

In his study, Korkmaz used survival analysis procedures including life tables, log-normal regression models, and proportional hazards models. His study draws on Bowman and Mehay (2002) and Mehay and Bernard (2003) in the choice of the variables to be included in the analysis.[68] He defined the survivor function as the probability of staying in the Navy beyond the year 2000. The hazard is defined as the instantaneous risk that an officer will leave the Navy at a particular time.[69] Korkmaz used the number of months an officer served in the Navy as his dependent variable. The censoring variable he used shows whether an officer separated from the Navy.

Korkmaz used data derived from Navy Officer Data Card Information for officers who were commissioned between 1983 and 1990. The data set has 753 variables and contains information for 34,991 Naval officers. The observations that were missing critical data were removed from the sample.

The results of the study show that the estimated survivor function is horizontal from 48 to 60 months. Between 60 and 120 months, the survivor function declines. After 120 months, the function is nearly flat when compared with the interval between 60 and

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[68] Ibrahim Korkmaz, *Analysis of the Survival Patterns of United States Naval Officers*. (Monterey, California: Naval Postgraduate School, March 2005).

[69] Ibid.

120 months. The reason survival is flat between months 48 and 60 is the initial obligated service after commissioning. The reason survival is flat after month 120 is related to promotion to the O-4 rank.[70]

Korkmaz found that the survival curves for different commissioning sources are identical up to 48 months. After 48 months he found the following:[71]

- Graduates of the USNA have the highest survival curve between 48 and 60 months. This is because of an extra year of obligated time for USNA graduates. This high survival curve continues up to 80 months of service.

- ROTC contract accessions have the highest survival curve between 80 and 120 months.

- Other commissioning sources (other than the USNA, ROTC scholarships, ROTC contracts, and OCS) have the highest survival curves between 120 and 170 months.

- OCS and ROTC scholarships have the highest survival curves after 170 months.

- ROTC scholarships have the lowest survival curve among the commissioning sources at any time.

Korkmaz points out that the hazard ratio for Naval officers increases to the highest point after completing initial obligated service time. Up to O-4, the hazard ratio decreases slightly. At promotion to O-4, the hazard ratio reaches the same level as at the end of obligated service. After promotion to O-4, the hazard ratio decreases greatly.[72]

Officer groups from different designators have different survival functions according to the study. Aviators have the highest survival function up to 100 months, most likely because of their longer initial obligated time. After 100 months, the survival function is the highest in the special warfare community. The next highest survival

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[70] Ibrahim Korkmaz, *Analysis of the Survival Patterns of United States Naval Officers*. (Monterey, California: Naval Postgraduate School, March 2005).

[71] Ibid.

[72] Ibid.

function is for those in the medical and other restricted line and staff officers. The survival function is the lowest for surface warfare and submarine officers.[73]

There are some missing data in the data set that Korkmaz used. This is a limitation of the study. Missing data may decrease the reliability of the results.

3.   Hoglin (2004)

In his thesis *Survival Analysis and Accession Optimization of Prior Enlisted United States Marine Corps Officers*, Hoglin (2004) identified the effect of prior enlistment on officer longevity. He used the Cox proportional hazards model for his study.

Hoglin used the Marine Corps Commissioned Officer Accession Career (MCCOAC) data file for the analysis. The data file includes officers commissioned between 1980 and 1999. The data have some limitations, including the reliability of some cohort data.[74]

Hoglin gained insights from prior studies by O'Brien (2002) and Ergun (2003) when he was choosing the variables to be included in his model. When defining the marital status variable, he assumed that longevity would be affected by current marital status rather than marital status immediately after commissioning. Therefore, he used the last record of marital status. In one of his models, he replaced the prior enlisted variable with the highest rank prior to commissioning. However, only E-3 and E-4 ranks were found to be significant in this model.

Hoglin discussed the following commissioning sources in his study:

- United States Naval Academy (USNA)

- Naval Reserve Officer Training Corps (NROTC)

- Platoon Leaders Course (PLC)

- Officer Candidate Course (OCC)

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[73] Ibrahim Korkmaz, *Analysis of the Survival Patterns of United States Naval Officers*. (Monterey, California: Naval Postgraduate School, March 2005).

[74] Philip Hoglin, *Survival Analysis and Accession Optimization of Prior Enlisted United States Marine Corps Officers*. (Monterey, California: Naval Postgraduate School, March 2004).

- Marine Corps Enlisted Commissioning Education Program (MECEP)

- Enlisted Commissioning Program (ECP)

- Meritorious Commissioning Program (MCP)

The results of the study indicate that having been enlisted prior to commissioning has a small effect on survival rates, and that the commissioning source has a strong effect. PLC, OCC, NROTC, and ECP were all found to have lower survival rates when compared with USNA. The only commissioning source that was found to have a higher survival rate than USNA was the MECEP program.

Hoglin also found that the commissioning age had a small effect on survival rates, and being married had a large, positive effect. Combat and combat service support officers were found to have lower survival rates than officers in combat support MOS.

Another significant variable was the The Basic School (TBS) class. Officers graduating in the top third of TBS class had little effect on survival rates compared with the middle and bottom third of the class. Neither gender nor ethnicity was found to have a significant effect on survival rates.[75]

4.   Bernard (2002)

In his thesis *An Analysis of Alternative Accession Sources for Naval Officers*, Bernard (2002) analyzed the effect of the commissioning source on the retention and promotion of Naval officers up to O-4. He estimated the effect of accession sources on Unrestricted Line (URL) and Restricted Line (RL) officer retention and promotion. He also analyzed relative cost effectiveness of the commissioning sources. He used nonlinear logit regression models because he believed that the hypothesis about the relationship between the dependent and independent variables was non-linear.[76]

Bernard used Navy Officer Data Card information for his thesis. The data set contained information for both URL and RL officers for 1983 through 1990. There were 295 personal characteristics in the data file. At the beginning of Bernard's study, there

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[75] Philip Hoglin, *Survival Analysis and Accession Optimization of Prior Enlisted United States Marine Corps Officers*. (Monterey, California: Naval Postgraduate School, March 2004).

[76] Joel P. Bernard, *An Analysis of Alternate Accession Sources for Naval Officers*. (Monterey, California: Naval Postgraduate School, March 2002).

were 25,212 officers in the data set. However, he retained officers whose ages were between 20 and 30 only, resulting in 17,134 URL and 5,129 RL officers.[77]

Bernard used two variables as outcomes in his study. One measures whether an officer survived to O-4; the other variable measures whether that officer was promoted to O-4. The explanatory variables he used concern demographics, human capital, college selectivity, and community designators. Bernard gained insights from Bowman (1995), Mehay (1995), and Bowman and Mehay (2002) when he chose the variables to include in his model.

The results of his study indicate that the accession source significantly affects stay or leave decisions and promotions. He found the following:[78]

- The USNA is the most cost effective commissioning source.

- In one of the URL models, ROTC scholarship and ROTC contract accessions were more likely to stay to O-4 when compared with USNA accessions.

- In the RL models, ROTC scholarship, ROTC contract, and OCS graduates were more likely to stay to O-4 than USNA graduates.

- For both URL and RL officers, ROTC scholarship and OCS accessions who attended elite colleges and universities were less likely to stay than USNA accessions.

- Prior service had a large positive effect on retention to O-4. However, technical majors and higher undergraduate GPAs had a negative effect. This is the same for both URL and RL officers.

Bernard's recommendation was that USNA be considered as the primary source to meet future demand for officers as long as it operates fewer than 4,400 midshipmen which is the design capacity for USNA.[79]

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[77] Joel P. Bernard, *An Analysis of Alternate Accession Sources for Naval Officers.* (Monterey, California: Naval Postgraduate School, March 2002).

[78] Ibid.

[79] Ibid.

5. Kizilkaya (2004)

In his thesis *An Analysis of the Effect of Commissioning Sources on Retention and Promotion of U.S. Army Officers*, Kizilkaya (2004) identified the effects of commissioning sources on the career progression of U.S. Army officers. He examined retention to O-4 and used logistic regressions for his analysis. Four major accession programs are discussed in his study:

- The United States Military Academy (USMA)

- Reserve Officer Training Corps (ROTC)

- Officer Candidate School (OCS)

- Direct Appointment

Kizilkaya used data from the Active Duty Master File. The data set had 460 variables on cohort groups commissioned from 1981 though 2001. He created pooled retention and promotion data sets for descriptive and multivariate analyses.

Variable selection in this study was derived from Kabalar (2003). Kizilkaya used variables that represent personal and military demographic information, career timeline events, military occupation information, and military test score information. He used the variable *RETAINED* as the dependent variable in the retention model, where 1 indicates the officer stayed 10 years after commissioning and 0 means otherwise. Variables for marital status and the number of dependents show the status of the officers at the fourth-year point because: 1) Promotion to Captain occurs after four years, and 2) Active duty service obligation for the majority of commissioned officers is four years. Kizilkaya suggested that an alternative to the fourth-year point would be to look at the status of the officers in the year of commissioning. He also pointed out that this alternative approach would cause bias because Academy graduates are not allowed to marry until graduation.[80]

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[80] Zafer Kizilkaya, *An Analysis of the Effect of Commissioning Sources on Retention and Promotion of U.S. Army Officers.* (Monterey, California: Naval Postgraduate School, June 2004).

For military occupation, Kizilkaya used the variable *DPOG* to reflect the DOD Primary Occupation Code. Tactical operations officers, intelligence officers, engineering and maintenance officers, health care officers, administrators, supply, procurement, and allied officers were analyzed in the study.

Kizilkaya found commissioning source to be an important determinant of retention and promotion in the Army. His results indicate the following:[81]

- USMA graduates have the lowest retention rates. They are less likely to stay in the Army until selection for promotion to Major.

- OCS graduates have the highest retention rates.

- Male ROTC graduates have higher retention rates than male direct appointment officers.

- Female Direct Appointment officers have higher retention rates than female ROTC graduates.

- Being married seems to have a positive effect on retention and promotion to O-4.

- Being prior enlisted does not seem to affect retention and promotion to O-4.

- The effects of the DOD Primary Occupation Group and number of dependents are not found to be statistically significant in the models.

Kizilkaya did not analyze ROTC scholarships and ROTC contract graduates separately. He used a single variable for ROTC graduates.

One of the limitations of the study concerns the explanatory variables in the data set. Kizilkaya suggests that more accurate results could have been produced if variables about officer evaluation reports and awards that are expected to affect retention of officers had been used.

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[81] Zafer Kizilkaya, *An Analysis of the Effect of Commissioning Sources on Retention and Promotion of U.S. Army Officers.* (Monterey, California: Naval Postgraduate School, June 2004).

6. Perry (2006)

In his study *An Analysis of Primary Military Occupational Specialties on Retention and Promotion of Mid-grade Officers in the U.S. Marine Corps*, Perry identified the effects of Primary Military Occupational Specialty (PMOS) on the probability of promotion to O-4 and O-5, and on surviving to year ten of commissioned service for Marine Corps Officers. The study also looked at whether there are differences in promotion probabilities and survival rates between officers in the combat arms occupational field and other fields. Perry used logistic regression and Cox-proportional hazard models in his study.

Two different data sets were used in the study:

- The Marine Corps Commissioned Officer Accession Career (MCCOAC) Data File

- Defense Manpower Data Center (DMDC) Marine Officer Cohort Data File

The MCCOAC data file contains information from FY 1980 through 1999 and contains demographic information, commissioning information, and general information. The DMDC Marine Officer Cohort Data File contains information from FY 1980 through FY 2001.

For his retention model, Perry used a dependent variable that indicated whether an officer stayed in the Marine Corps for more than 119 months. Perry's main hypothesis was that PMOS may affect retention because quality of life varies across military occupations.[82] Perry expected that officers are more likely to remain in service if they have a better quality of life or job satisfaction.

The results of the study indicate that:[83]

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[82] Tracy A. Perry, *An Analysis of Primary Military Occupational Specialties on Retention and Promotion of Mid-Grade Officers in the U.S. Marine Corps*. (Monterey, California: Naval Postgraduate School, March 2006).

[83] Ibid.

- PMOS has a statistically significant effect on the survival of Marine Corps officers until 10 years of commissioning service (YCS). The occupational field is found to be correlated with the probability of retention when PMOSs are aggregated.

- The base case for PMOS is the infantry in this study. When compared to the infantry, only the pilot PMOSs were more likely to be retained until 10 YCS. All other PMOSs were less likely to be retained.

- There are two different promotion models in the study. The promotion to O-4 model indicates that PMOSs within the fixed and rotary wing occupational fields are less likely to promote to O-4 than the infantry. PMOS. The promotion to O-5 model indicates that some of the PMOSs (intelligence, engineer, public affairs, air defense control) have significant effects on promotion to O-5. When PMOSs are aggregated, only the ground support occupational field is found to be significant. Officers from ground support occupational field are less likely to be promoted to O-5 than those from the base case occupational field, combat arms.

7.   Hosek et al. (2001)

In their study, *Minority and Gender Differences in Officer Career Progression*, Hosek, et al. investigated whether or not there are patterns of differences in retention and promotion for different racial, ethnic, and gender groups. The study specifically compared the following:[84]

- How officers in different minority/gender groups enter military service

- Whether they choose to stay in service

- Whether they are selected for promotion

The study analyzed the records of seven cohorts (76,000 officers) who were commissioned between the 1967 and 1991 and specifically looked at seven cohorts. Data were provided by DMDC. The independent variables were race, ethnicity, marital status,

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[84] Susan D. Hosek, et al, *Minority and Gender Differences in Officer Career Progression*, (Santa Monica, California: The RAND Corporation, 2001).

commissioning source, occupation, rank, cohort, military service, and prior enlisted status. Logistic regression was used for estimation.

In general, women were found less likely to reach O-4 and above than men. Blacks were not significantly less likely to promote to O-4 and above than whites. Black male officers were less likely to be promoted than white male officers. They were also more likely to remain in service between promotions. Black female officers were less likely to be promoted when compared with all other groups. Prior enlisted people were found to be quite successful as junior officers. However, a different situation is observed in subsequent years. They reach 20 years of total service (retirement eligibility) before their peers. This results in fewer prior service officers remaining in commissioned service after the 20th year.[85] The study found no differences in the career progression patterns of minorities and women in the Army, Air Force, Navy and Marine Corps.

Hosek, et al.'s findings about the effects of commissioning source and occupation on retention and promotion were similar to Bowman (1990), Mehay (1995), and North, et al (1995). According to all of these studies, commissioning sources and occupation are important factors in retention and promotion.

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[85] Susan D. Hosek et al, *Minority and Gender Differences in Officer Career Progression*, (Santa Monica, California: The RAND Corporation, 2001).

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V.   METHODOLOGY

This chapter describes the methodology that was used for this study. The first section discusses survival analysis and includes a description of the three SAS survival analysis procedures used in the study:

- PROC LIFETEST

- PROC LIFEREG

- PROC PHREG

The second section deals with model specification, and the last section describes the variables used in the models.

A.   SURVIVAL ANALYSIS

"Survival analysis is a class of statistical methods for studying the occurrence and timing of events."[86] Survival analysis methods were originally designed for studying deaths in medical studies but are now widely used in the social and natural sciences. Equipment failures, diseases, earthquakes, automobile accidents, stock market crashes, revolutions, job terminations, births, marriages, divorces, promotions, retirements, and arrests can all be studied by using survival analysis. In order to apply survival analysis, one should know when a change or event of interest for an observation has occurred.

Survival analysis has two important features: censoring and time-dependent covariates, which are difficult to handle with conventional statistical methods. Censoring occurs when an event for an observation doesn't take place before the end of the study (or data coverage). Therefore, a censored observation is an observation with incomplete information. There are different forms of censoring. Right Censoring occurs when there is a variable that has observations greater than a specific value. Left censoring occurs when there is a variable that has observations smaller than a specific value. Right-censoring is more common in the social sciences. In Type I censoring, the censoring time is fixed; all the observations have the same censoring time. However, in Type II censoring, an observation is terminated after a specific number of events have occurred.

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[86] Paul D. Allison, *Survival Analysis Using SAS* (SAS Publishing, North Carolina, 2003), 1.

In the social sciences, Type I censoring is more common. If the reasons for the termination of the observations are not under control, random censoring occurs. Time-dependent covariates are the independent variables that may change in value over the course of observation, such as marital status or number of children."[87] Survival analysis allows for the inclusion of these kinds of variables in models.

There are several different models for survival data. The main difference between models concerns the probability distribution of the event time for a particular individual. The different types of distribution functions are:

- Cumulative distribution Function (c.d.f.)

- Probability Density Function (p.d.f.)

- Hazard Function

The c.d.f. of a variable indicates the probability that the variable will be less than or equal to any value chosen. The survivor function (p.d.f.) is more commonly used in survival analysis than the c.d.f.. The p.d.f. is the derivative of the c.d.f. The hazard function indicates the instantaneous risk that an event will occur at a specific time. These three functions all describe a continuous probability distribution. If one is known, the other two can be found.

1. Proc Lifetest

PROC LIFETEST is a SAS procedure that is useful for preliminary survival data analysis. It describes the survivor function and tests whether the survivor functions for two or more groups are identical. There are three ways to test for different survivor function in PROC LIFETEST:

- The log-rank test

- The Wilcoxon test

- The likelihood ratio statistic

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[87] Paul D. Allison, *Survival Analysis*, 138.

PROC LIFETEST computes and graphs the estimated survivor function. It also tests for associations between survival time and sets of quantitative covariates.[88]

Today, survival curves are very useful for the following purposes:

- Preliminary examination of the data

- Computing derived quantities from regression models

- Evaluating the fit of regression models

PROC LIFETEST uses the following methods for estimating survivor functions:

- The Kaplan-Meier Method

- The Life-Table Method

The Kaplan-Meier method is more suitable for small data sets whereas the life-table method is more suitable for large data sets.

2.   Proc Lifereg

The PROC LIFEREG in SAS procedure uses maximum likelihood to estimate parametric regression models with censored survival data[89]. In recent years PROC PHREG, which uses a partial likelihood method for doing semi-parametric regression analysis, has become popular. However, PROC LIFEREG is better than PROC PHREG in several ways for the following reasons:[90]

- PROC LIFEREG allows left censoring and interval censoring, whereas PROC PHREG allows only right censoring.

- PROC LIFEREG allows testing for hypotheses regarding the shape of the hazard function. PROC PHREG gives only non-parametric estimates of survivor function.

- PROC LIFEREG produces more efficient estimates than PROC PHREG if the shape of the survival distribution is unknown.

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[88] Paul D. Allison, *Survival Analysis*, 29.

[89] Ibid, 61.

[90] Ibid, 61, 62.

The most important limitation of PROC LIFEREG is that it does not handle time-dependent covariates. PROC PHREG can do this. However, the rich array of survival distributions is an attractive feature of PROC LIFEREG. The alternative models for PROC LIFEREG are:

- The Exponential Model

- The Weibull Model

- The Log-Normal Model

- The Log-Logistic Model

- The Gamma Model

PROC LIFEREG is less robust than PROC PHREG. However, most of the time, the results of the two approaches are similar.

3. Proc Phreg

PROC PHREG is the newest SAS procedure for survival analysis and is widely used. This procedure implements the regression method that was proposed in 1972 by the British statistician Sir David Cox,[91] and is referred to as the "Cox regression." Sir David Cox proposed a model called the "proportional hazards model," which is so named because the hazard for any individual is a fixed proportion of the hazard for any other individual. Cox also proposed a new estimation method called "maximum partial likelihood." Cox regression is the combination of the model and the estimation method.

For PROC PHREG, there is no need to choose a particular probability distribution to represent survival times, which makes the procedure very popular. It is also relatively easy to incorporate time-dependent covariates that may change over the observation period. The procedure can be used for discrete-time and continuous-time data. It is also easy to adjust for periods in which an individual is not at risk of an event with PROC PHREG.

The weakness of PROC PHREG is the lack of built-in graphics. However, it is possible to program graphs with the help of the output data sets.

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[91] Paul D. Allison, *Survival Analysis Using SAS*, 111.

B. MODEL SPECIFICATION

The model developed for this study is based on information from a number of other studies: Korkmaz (2005), Bernard (2002), Kizilkaya (2004), Hoglin (2004), Perry (2006), and Hosek, et al (2001). The model draws mainly on Korkmaz and Kizilkaya for variable selection. But since Korkmaz bases his approach on Bowman and Mehay, and Mehay and Bernard, and Kizilkaya draws on Kabalar, it is clear that the model in this study draws on all of these prior studies.

In this study, the event of interest is leaving the military. Therefore, the survivor function is the probability of staying in the military beyond t.

The hazard for an officer at time t is specified as follows:

$h_i(t)=\lambda_0(t) \times$ exp (f (Commissioning Age, Gender, Race, Prior Enlisted, Marital Status, Graduate-level Education, Commissioning Source, Occupation Code [Occupation Category], Commissioning Year)).

In this study, 2004 is the year in which officers were last observed. Therefore the survivor function is the probability of staying in the Army beyond the year 2004.

C. VARIABLE DESCRIPTION

The model that is used for this study draws mainly on Korkmaz and Kizilkaya for the selection of variables. Two variables are needed to construct the dependent variable for survival analysis. The first is the duration and the second is the censoring variable.

The dependent variable *N_ARMY* is the duration variable in this study. It shows the number of years a valid pay grade appears. This variable is generated by counting the pay grades for every officer in the data set. The censoring variable is *SEPARATE*. It shows whether the officer left the military. The independent variables include:

- Demographic Characteristics
- Commissioning Source
- Occupation Codes (Occupation Categories)
- Career Characteristics
- Education
- Cohort Year

Table 3 indicates the variables and their definitions. For binary variables, the base case is noted.

Table 3.   Variable Descriptions

VARIABLE	DEFINITION
DEPENDENT VARIABLE	
N_ARMY	NUMBER OF YEARS A VALID PAYGRADE APPEARS
CENSORING VARIABLE	
SEPARATE	= 1 IF SEPARATED FROM THE SERVICE
	= 0 IF IN THE SERVICE
DEMOGRAPHICS	
AGE	
AGE	AGE AT COMMISSIONING
RACE/ETHNICITY	
WHITE	= 1 IF WHITE (BASE)
	= 0 OTHERWISE
BLACK	= 1 IF BLACK
	= 0 OTHERWISE
HISPANIC	= 1 IF HISPANIC
	= 0 OTHERWISE
OTHERRACE	= 1 IF OTHER RACE
	= 0 OTHERWISE
GENDER	
FEMALE	= 1 IF FEMALE
	= 0 IF MALE (BASE)
FAMILY STATUS	
MARRIED	= 1 IF MARRIED
	= 0 IF SINGLE (BASE)
NUMBER OFDEPENDENTS	
NOFDEPENDENTS	NUMBER OF NON-SPOUSAL DEPENDENTS
COMMISSIONING SOURCE	
ACADEMY	= 1 IF COMMISSIONING SOURCE IS USMA (BASE)
	= 0 OTHERWISE
ROTCSCHOLAR	= 1 IF COMMISSIONING SOURCE IS ROTC SCHOLARSHIP
	= 0 OTHERWISE
ROTCNONSCHOLAR	= 1 IF COMMISSIONING SOURCE IS ROTC CONTRACT
	= 0 OTHERWISE
OCS	= 1 IF COMMISSIONING SOURCE IS OCS
	= 0 OTHERWISE
DIRAPPOINT	= 1 IF COMMISSIONING SOURCE IS DIRECT APPOINTMENT
	= 0 OTHERWISE
OCCUPATION CODE	
IACF	= 1 IF INFANTRY OR ARMOR OR CAVALRY OR FIELD ARTILLERY (BASE)
	= 0 OTHERWISE
AVIATION	= 1 IF AVIATOR
	= 0 OTHERWISE
AIRDARTILLERY	= 1 IF AIR DEFENSE ARTILLERY
	= 0 OTHERWISE
INTELLIGENCE	= 1 IF INTELLIGENCE
	= 0 OTHERWISE

ENGINEERING	= 1 IF ENGINEER OR MAINTENANCE OFFICER
	= 0 OTHERWISE
SPECIAL	= 1 IF JUDGE OR CHAPLAIN OR MEDICAL CORPS
	= 0 OTHERWISE
ADMINISTRATIVE	= 1 IF ADMINISTRATOR
	= 0 OTHERWISE
MILPOLICE	= 1 IF MILITARY POLICE
	= 0 OTHERWISE
LOGISTICIAN	= 1 IF LOGISTICIAN
	= 0 OTHERWISE
SUPPLY	= 1 IF SUPPLY OFFICER
	= 0 OTHERWISE
TRANSPORTATION	= 1 IF TRANSPORTATION OFFICER
	= 0 OTHERWISE
OCCUPATION CATEGORY CODE	
COMBATARMS	= 1 IF CAREER FIELD IS COMBAT ARMS (BASE)
	= 0 OTHERWISE
COMBATSUPPORT	= 1 IF CAREER FIELD IS COMBAT SUPPORT
	= 0 OTHERWISE
COMBATSERVICESUPPORT	= 1 IF CAREER FIELD IS COMBAT SERVICE SUPPORT
	= 0 OTHERWISE
SPECIALBRANCHES	= 1 IF CAREER FIELD IS SPECIAL BRANCHES
	= 0 OTHERWISE
CAREER CHARACTERISTICS	
PRIORENLISTED	= 1 IF PRIOR ENLISTED
	= 0 OTHERWISE (BASE)
EDUCATION	
GRADEDUCATION	= 1 IF HAS GRADUATE EDUCATION
	= 0 OTHERWISE (BASE)
COHORT YEAR	
FY81	= 1 IF COMMISSIONED IN 1981; = 0 OTHERWISE (BASE)
FY82	= 1 IF COMMISSIONED IN 1982; = 0 OTHERWISE
FY83	= 1 IF COMMISSIONED IN 1983; = 0 OTHERWISE
FY84	= 1 IF COMMISSIONED IN 1984; = 0 OTHERWISE
FY85	= 1 IF COMMISSIONED IN 1985; = 0 OTHERWISE
FY86	= 1 IF COMMISSIONED IN 1986; = 0 OTHERWISE
FY87	= 1 IF COMMISSIONED IN 1987; = 0 OTHERWISE
FY88	= 1 IF COMMISSIONED IN 1988; = 0 OTHERWISE
FY89	= 1 IF COMMISSIONED IN 1989; = 0 OTHERWISE
FY90	= 1 IF COMMISSIONED IN 1990; = 0 OTHERWISE
FY91	= 1 IF COMMISSIONED IN 1991; = 0 OTHERWISE
FY92	= 1 IF COMMISSIONED IN 1992; = 0 OTHERWISE
FY93	= 1 IF COMMISSIONED IN 1993; = 0 OTHERWISE
FY94	= 1 IF COMMISSIONED IN 1994; = 0 OTHERWISE
FY95	= 1 IF COMMISSIONED IN 1995; = 0 OTHERWISE
FY96	= 1 IF COMMISSIONED IN 1996; = 0 OTHERWISE
FY97	= 1 IF COMMISSIONED IN 1997; = 0 OTHERWISE
FY98	= 1 IF COMMISSIONED IN 1998; = 0 OTHERWISE
FY99	= 1 IF COMMISSIONED IN 1999; = 0 OTHERWISE
FY00	= 1 IF COMMISSIONED IN 2000; = 0 OTHERWISE
FY01	= 1 IF COMMISSIONED IN 2001; = 0 OTHERWISE

1. Demographic Variables

The variable AGE shows the age at entry and is a continuous variable. Higher age at entry is expected to have a positive effect on the survival curves of officers because more experience at entry may lead to a higher level of professional success.[92] This is why it is expected that officers with a higher age at commissioning will tend to have longer time of service than those with a lower entry age in this study. There are some studies that support this idea. Hoglin found that commissioning age had a small positive effect on survival rates. However, officers who enter at older ages are also likely to be prior enlisted. In this case there is a possibility that their survival curves may be affected negatively.

There are four binary variables in the study that indicate race and ethnicity. These variables are WHITE, BLACK, HISPANIC, and OTHERRACE. The base case is the variable WHITE. Previous studies found differences in the retention and promotion for different racial and ethnic groups.[93] In general, minorities tend to stay in service longer than white officers.[94] This may be because of the positive perceptions of minorities about the pay and training opportunities in the military. They tend to stay in the military as long as these opportunities are perceived as better than those in civilian sector.[95] Therefore, in this study, it is expected that minorities will have a longer service time than white officers.

The binary variable FEMALE shows the gender of the officers. The base case is a male officer. The literature shows that gender affects retention and promotion.[96] Females have many family responsibilities, including the care of children that may conflict with

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[92] Ibrahim Korkmaz, *Analysis of the Survival Patterns of United States Naval Officers*. (Monterey, California: Naval Postgraduate School, March 2005).

[93] Susan D. Hosek, et al, *Minority and Gender Differences in Officer Career Progression*, (Santa Monica, California: The RAND Corporation, 2001).

[94] Ibrahim Korkmaz, *Analysis of the Survival Patterns of United States Naval Officers*.

[95] Mary L. Diaz, *Minority Perceptions of Opportunities and Intentions to Stay in the Navy*, (Monterey, California: Naval Postgraduate School, March 2005).

[96] Susan D. Hosek, et al, *Minority and Gender Differences in Officer Career Progression*.

military service. That is why females are expected to be less likely to reach O-4 and above than males and why shorter service time is expected for female officers compared with male officers in this study.

The binary variable SINGLE shows the marital status of the officers. Marital status variables used in the literature show the marital status at different times in a person's career. Some studies use marital status at the fourth year because promotion to Captain occurs after four years. Four years is also the period of active duty service obligation for a majority of the officers.[97] Some studies assume that longevity is affected by current marital status, which is why the last record of marital status is used in these studies.[98] This study uses the last valid record of marital status. Being married has been shown to have a large positive effect on survival rates in other studies.[99] Literature points out that marriage increases the productivity of people at work. Increased productivity is associated with a longer service time for officers. There are two main assumptions[100] supporting the view that marriage increases productivity. First, marriage causes the husband to specialize in the labor market. Second, marriage causes faster human capital acquisition for the husband. Increased productivity caused by these two reasons affects promotion and the officers who promote tend to stay in the military for a longer time. This is why each additional year spent in marriage has been found to increases retention probabilities.[101] Another factor related to marriage is that the responsibilities of married officers are greater than those of single officers.[102] Therefore, longer service time is expected for married officers in this study compared to single officers.

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[97] Zafer Kizilkaya, *An Analysis of the Effect of Commissioning Sources on Retention and Promotion of U.S. Army Officers.* (Monterey, California: Naval Postgraduate School, June 2004).

[98] Philip Hoglin, *Survival Analysis and Accession Optimization of Prior Enlisted United States Marine Corps Officers*, (Monterey, California: Naval Postgraduate School, March 2004).

[99] Ibid.

[100] Guray Cerman and Bulent Kaya, *An Analysis of the Effect of Marital and Family Status on Retention, Promotion, and On-the-Job Productivity of Male Marine Corps Officers,* (Monterey, California: Naval Postgraduate School, March 2005).

[101] Ibid.

[102] Tracy A. Perry, *An Analysis of Primary Military Occupational Specialties on Retention and Promotion of Mid-Grade Officers in the U.S. Marine Corps.* (Monterey, California: Naval Postgraduate School, March 2006).

The variable NOFDEPENDENTS shows the number of non-spousal dependents of the officers. Some officers in the data set have military spouses. For the officers who do not have military spouses, 1 is subtracted from the number of dependents in order to obtain the number of non-spousal dependents. The literature shows that the number of non-spousal dependents has a positive effect on retention and promotion.[103] This may be mainly because the responsibilities of the individuals are directly proportional with the number of dependents they have. Therefore, longer service time is expected as the number of dependents increases in this study.

2. Commissioning Source Variables

ACADEMY, ROTCSCHOLAR, ROTCNONSCHOLAR, OCS, and DIRAPPOINT are the commissioning source variables that are used in this study. ACADEMY is the base case. The literature indicates that the commissioning source has a strong effect on survival rates,[104] retention, and promotion.[105] Some studies found that USMA graduates have the lowest retention rates, whereas OCS graduates have the highest retention rates.[106] However, in this study, since the USMA is a 24-hour-a-day, four year program of drill and instruction,[107] and since the cadets know this before entering USMA, it is expected that they will have a longer time of service than the officers from other sources. They volunteer for that difficult drill and instruction college program.

3. Occupation and Occupation Category Variables

AVIATION, IACF (Infantry, Armor, Cavalry and Field Artillery), AIRDARTILLERY, INTELLIGENCE, ENGINEERING, SPECIAL, ADMINISTRATIVE, MILPOLICE, LOGISTICIAN, SUPPLY, and TRANSPORTATION are the occupation variables that are used in this study. The base

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[103] Guray Cerman and Bulent Kaya, *An Analysis of the Effect of Marital and Family Status on Retention, Promotion, and On-the-Job Productivity of Male Marine Corps Officers.*

[104] Philip Hoglin, *Survival Analysis and Accession Optimization of Prior Enlisted United States Marine Corps Officers.*

[105] Susan D. Hosek, et al, *Minority and Gender Differences in Officer Career Progression.*

[106] Zafer Kizilkaya, *An Analysis of the Effect of Commissioning Sources on Retention and Promotion of U.S. Army Officers.* (Monterey, California: Naval Postgraduate School, June 2004).

[107] Michael R. Thirtle, *Educational Benefits and Officer-Commissioning Opportunities Available to U.S. Military Service Members*, (Santa Monica, CA: The RAND Corporation, 2001).

case is the IACF MOS. Primary MOS has been found to have a statistically significant effect on Marine Corps Officers.[108] In this study of Army officers, all of the DPROG variables except for AVIATION are expected to have a negative sign when compared to IACF which is the base case. Aviators have a longer obligated service time than all of the others. That's why AVIATION is expected to have a positive sign. The reason why IACF is expected to have a positive sign when compared to all others except for AVIATION is that there are not a lot of job opportunities outside the military for these officers. Other career branches have more civilian job opportunities than the IACF officers are likely to have.

Another classification is also made based on aggregated career categories. The career category variables used in the study are COMBATARMS, COMBATSUPPORT, COMBATSERVICESUPPORT, and SPECIALBRANCHES. The base case for these variables is COMBATARMS. Some studies have found that there is no significant effect of occupation category on retention and promotion.[109] However, for the Navy, occupation category variables have been found to affect survival rates. The Combat Support Career Field has been shown to have greater survival rates than those of the Combat and Combat Service Support Career Fields.[110] In this study, Combat Arms officers are expected to have longer survival times since their civilian job opportunities are more limited than those of officers from other career categories.

4. Career Characteristics Variable

PRIORENLISTED is a binary variable that indicates whether the officer served as an enlistee before commissioning. The literature shows that prior enlisted officers have a longer service time.[111] However, studies have also found that prior enlisted people reach retirement eligibility before their peers, resulting in fewer prior service officers remaining

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[108] Tracy A. Perry, *An Analysis of Primary Military Occupational Specialties on Retention and Promotion of Mid-Grade Officers in the U.S. Marine Corps.* (Monterey, California: Naval Postgraduate School, March 2006).

[109] Zafer Kizilkaya, *An Analysis of the Effect of Commissioning Sources on Retention and Promotion of U.S. Army Officers.*

[110] Ibrahim Korkmaz, *Analysis of the Survival Patterns of United States Naval Officers.*

[111] Joel P. Bernard , *An Analysis of Alternate Accession Sources for Naval Officers*, (Monterey, California: Naval Postgraduate School, May 2003).

in subsequent years.[112] This is because they have higher age at commissioning. There are also some studies that have found that being prior enlisted does not seem to affect retention and promotion.[113] Prior enlisted officers are expected to have longer service times than the officers who are not prior enlisted in this study. This is mainly because they acquired enlisted experience and military skills which may affect both their performance and retention decisions positively.

5. Education Variable

GRADEDUCATION is a variable that shows whether the officer has graduate education. The following are some important points about graduate-level education in relation to retention:[114]

- Graduate-level education increases the obligated service time, job performance, and promotion possibilities.

- Graduate-level education increases the probability of finding a job in the labor market.

The first point has a positive effect on the length of service, whereas the second point has a negative effect on an officer's length of service. Officers who have graduate education are expected to have a longer service time in this study because the first point mentioned above is believed to have more impact on officers than the second one.

6. Cohort Year

In order to control for trends in retention, a variable for entry cohort year is included in the model. The binary variables FY82 through FY01 show the fiscal year the officer was commissioned. The base case is the 1981 cohort which is represented by the variable FY81.

Table 4 summarizes the hypothesized effects of the explanatory variables included in the model. The base case is indicated for binary variables.

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[112] Susan D. Hosek, et al, *Minority and Gender Differences in Officer Career Progression.*

[113] Zafer Kizilkaya, *An Analysis of the Effect of Commissioning Sources on Retention and Promotion of U.S. Army Officers.*

[114] Ibrahim Korkmaz, *Analysis of the Survival Patterns of United States Naval Officers.*

Table 4.   Hypothesized Effects

VARIABLE	HYPOTHESIZED EFFECT
DEMOGRAPHICS	
AGE	+
WHITE	BASE
BLACK	+
HISPANIC	+
OTHERRACE	+
MALE	BASE
FEMALE	-
MARRIED	BASE
SINGLE	-
NOFDEPENDENTS	+
COMMISSIONING SOURCE	
ACADEMY	BASE
ROTCSCHOLAR	-
ROTCNONSCHOLAR	-
OCS	-
DIRAPPOINT	-
OCCUPATION CODE	
IACF (Infantry+Armor+Cavalry+Field Artillery)	BASE
AVIATION	+
AIRDARTILLERY	-
INTELLIGENCE	-
ENGINEERING	-
SPECIAL	-
ADMINISTRATIVE	-
MILPOLICE	-
LOGISTICIAN	-
SUPPLY	-
TRANSPORTATION	-
OCCUPATION CATEGORY CODE	
COMBATARMS	BASE
COMBATSUPPORT	+
COMBATSERVICESUPPORT	+
SPECIALBRANCHES	+
CAREER CHARACTERISTICS	
PRIORENLISTED	+
EDUCATION	
GRADEDUCATION	+
COHORT YEARS	
FY81	BASE
FY82 – FY01,	(Binary variables for cohort years)

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VI. DATA

This chapter describes the data used in this study. The first section discusses the structure of the data while the second section provides descriptive statistics. The last section discusses the limitations of the data, which mainly stem from the deletion of observations with missing values.

A. STRUCTURE OF THE DATA

Data used for this study were taken from the Active Duty Military Master File provided by the Defense Manpower Data Center. The dataset contains information on 103,501 officers who were commissioned from 1981 to 2001. There are 460 variables for every officer representing the following:[115]

- Personal demographic information

- Military demographic information

- Career timeline events

- Military occupation information

- Military test score information

Some variables such as commissioning source, age at commissioning, gender, and prior enlistment status represent characteristics that do not change, while other variables such as marital status and pay grade can change and are tracked yearly. The yearly tracked variables cover 1981 through 2004. The dependent variable N_ARMY shows the number of years a valid pay grade appears and is generated by counting the valid pay grades for every officer. If there is a gap in yearly pay grades, then the observation is deleted.

B. DESCRIPTIVE STATISTICS

The length of service for officers in entry cohorts from 1981 to 2001varies from one to 24 years. For those who entered and left the data set during this time period, this measure represents the time from entry to separation. For those who continued active duty service beyond 2004, it measures time served up September 30, 2004. Figure 12

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[115] Zafer Kizilkaya, *An Analysis of the Effect of Commissioning Sources on Retention and Promotion of U.S. Army Officers,* (Monterey, California: Naval Postgraduate School, June 2004).

shows the length of service for all commissioned officers in the data set. As seen in the figure, the officers with three, four and five years of service make up the largest group. The numbers of officers who have a service time of three, four, and five years are 10,939, 17,824, and 12,240, respectively.

Survival analysis techniques are used in this study and the two important features of survival analysis are the use of time dependent covariates in the regressions and censored observations. There are censored observations in the data set (those who were still serving at the end of the observation period) and the "final" length of service of the censored observations is therefore unknown.
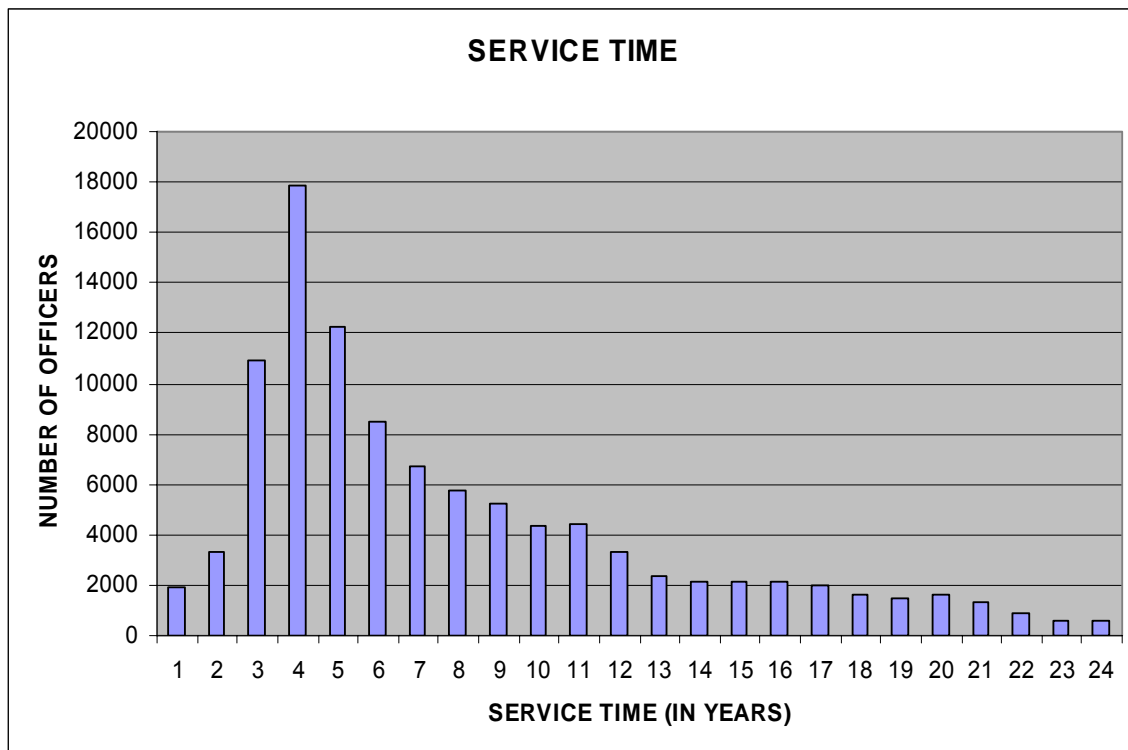
Figure 12.   Number of Officers by Service Time

Figure 13 provides information about separation status. It illustrates the number of commissioned officers from the 1981 to 2001 entry cohorts who had separated by September 30, 2004 by their years of service. As seen in the figure, the number of the officers who separated is highest in the fourth year of service, which is the end of obligatory service time. There is an increase in the number of separations in the 20th year due to retirement.

NUMBER OF SEPARATIONS BY YEAR OF SERVICE
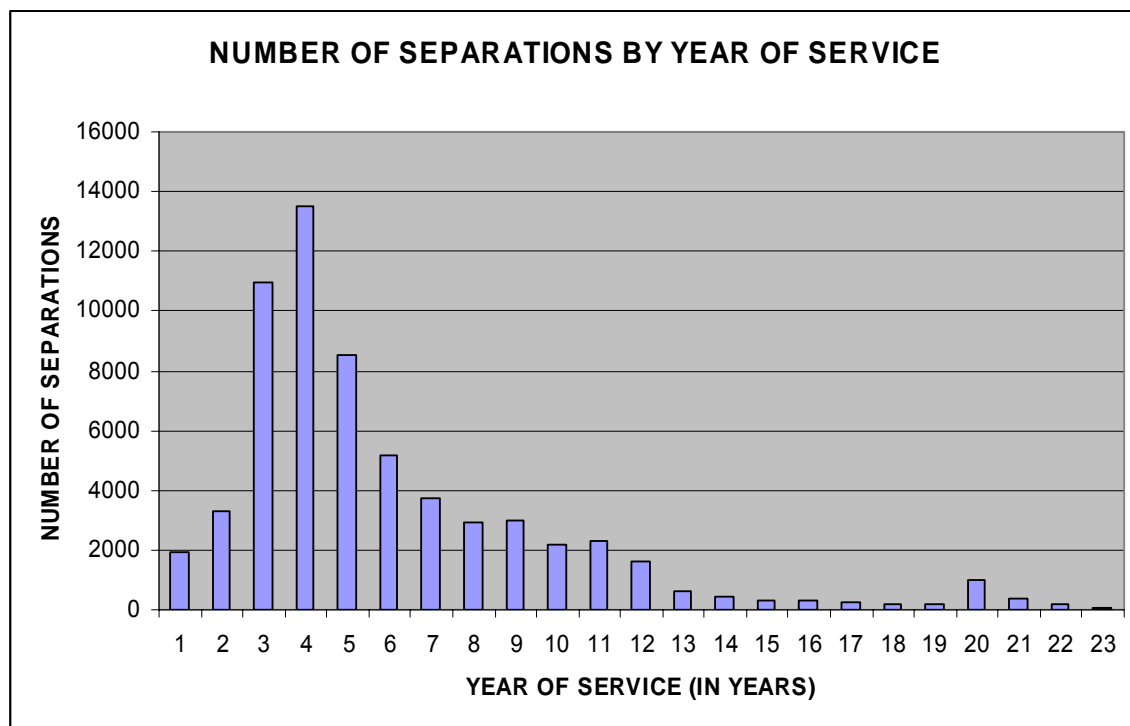
Figure 13.   Number of Separations by Year of Service

The Army commissioning sources used in this study are United States Military Academy (ACADEMY), Reserve Officers' Training Corps—Scholarship (ROTCSCHOLAR), Reserve Officers' Training Corps—Non-scholarship (ROTCNONSCHOLAR), Officer Candidate School (OCS) and Direct Appointments (DIRAPPOINT). Figure 14 shows the total number of officers who were commissioned through each source. The largest source of commissioned officers for the Army is the ROTC. The number of ROTC non-scholarship officers is 32,946 (32%) and they make up the largest group of commissioned officers in the Army. There are 28,034 (27%) ROTC scholarship officers and they constitute the second largest source of commissioned officers. USMA graduates make up 19% of the commissioned officers (19,048). The number of officers who were commissioned through Direct Appointment is 16,700 (16%). The smallest source of commissioned officers is OCS graduates; there are 6,413 (6%) OCS graduates in the data set.

COMMISSIONING SOURCES

DIRECT APPOINTMENT, 16700, 16%

OCS, 6413, 6%

USMA, 19408, 19%

ROTC (SCHOLAR), 28034, 27%

ROTC (NONSCHOLAR), 32946, 32%

Legend:
- USMA
- ROTC (SCHOLAR)
- ROTC (NONSCHOLAR)
- OCS
- DIRECT APPOINTMENT
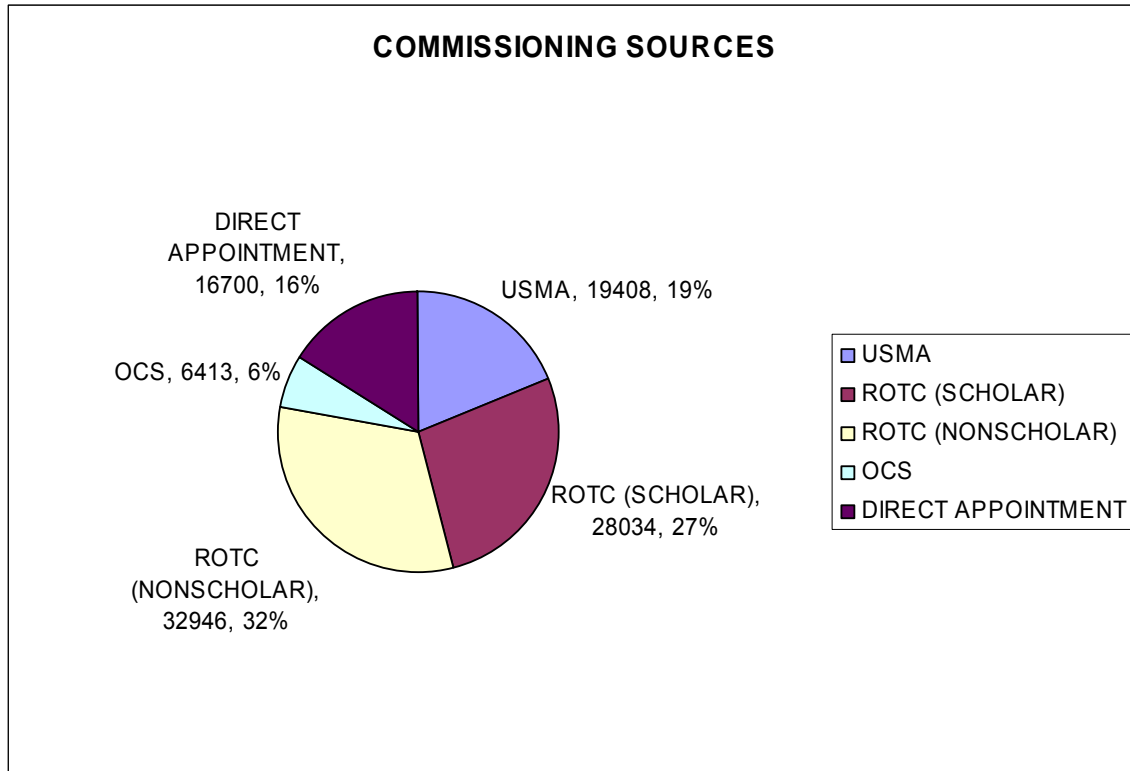
Figure 14.   Number of Officers by Commissioning Source

Figure 15 shows the length of service by commissioning source. The *y*- axis in the figure represents the percentage of officers by commissioning source. For example, 28% of the ROTC scholarship officers leave the military at the fourth year. As seen in the figure, there are substantial differences in the percentages of those who leave the service at the 3rd, 4th, and 5th years of service for different commissioning sources. Beyond five years, the percentages of the officers who leave the service are similar for all of the commissioning sources.
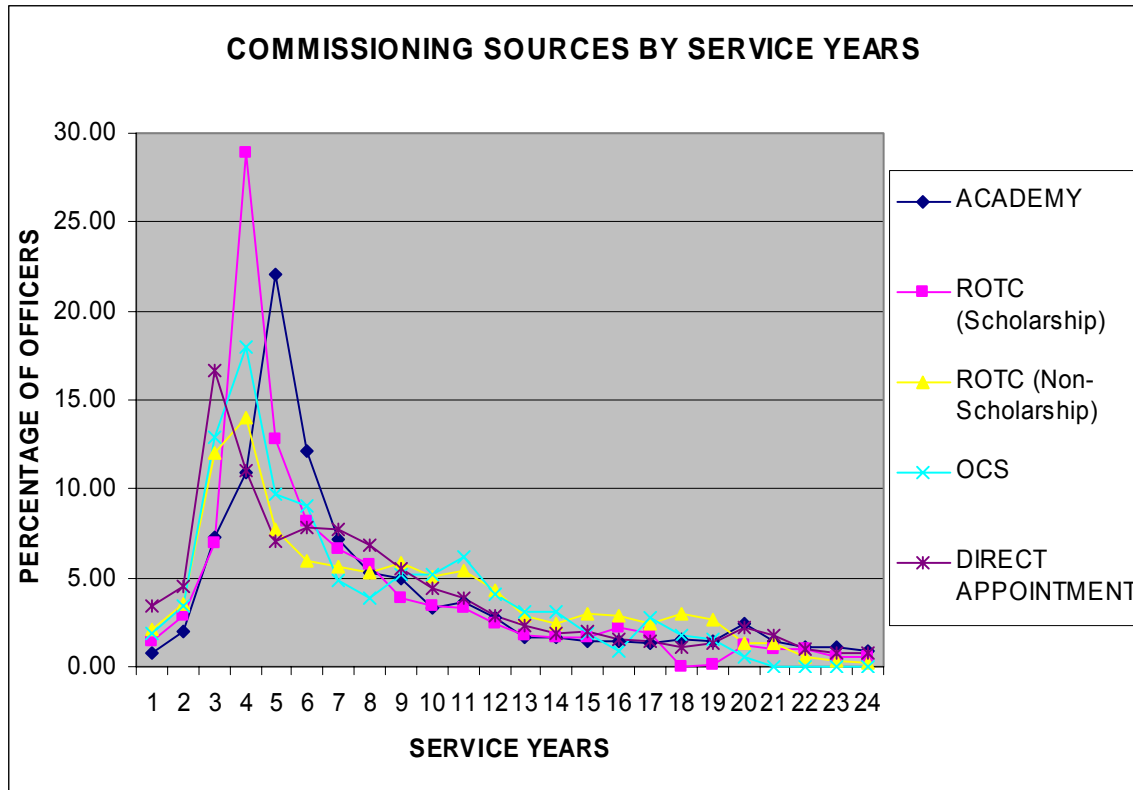
Figure 15.   Commissioning Sources by Year of Service

Commissioning age ranges from 17 to 35 as shown in Figure 16. The mean commissioning age for all of the officers in the data set is 23.68. For some officers, the commissioning age is unknown. The modal age at commissioning is 22.
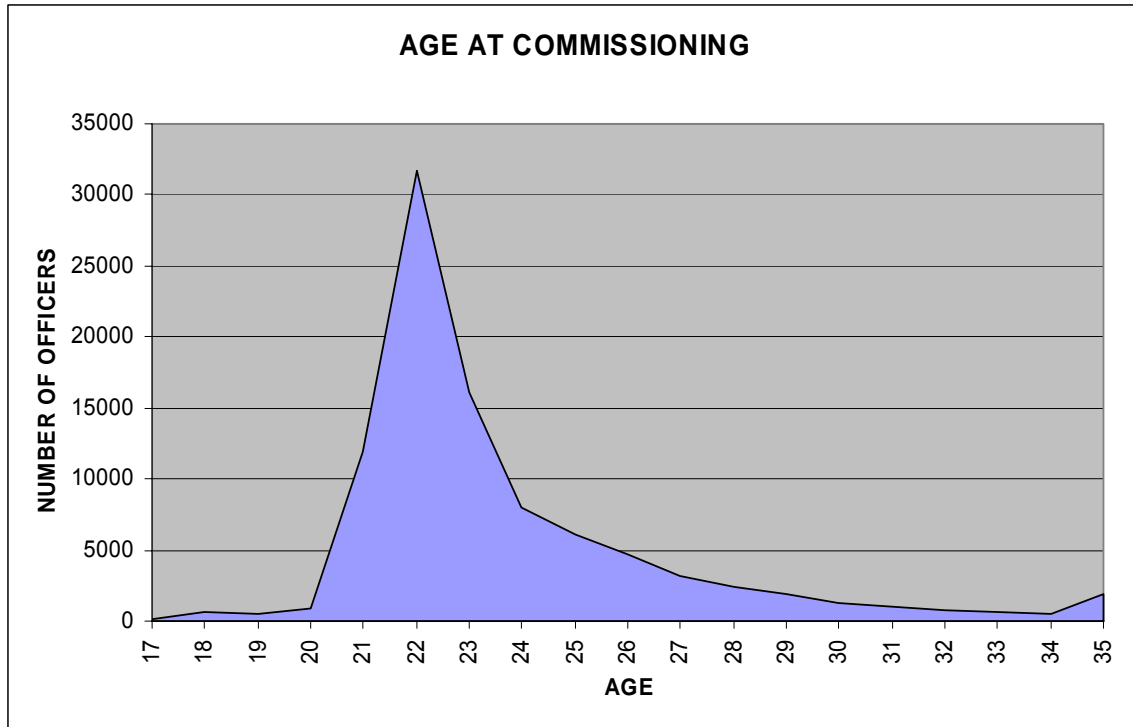
Figure 16.　Number of Officers by Age at Commissioning

The ethnicity variables that are used for this study are WHITE, BLACK, HISPANIC, and OTHERRACE. Figure 17 shows the number of commissioned officers by ethnicity. White officers make up 80% of the officers in all cohort groups. The second largest ethnicity group is black officers (10%). Hispanic officers make up 3% of the data set and other races make up 7%.

RACE / ETHNICITY

OTHER RACE,
7717, 7%

HISPANIC, 3103,
3%

BLACK, 10584,
10%

WHITE, 82097,
80%

- WHITE
- BLACK
- HISPANIC
- OTHER RACE
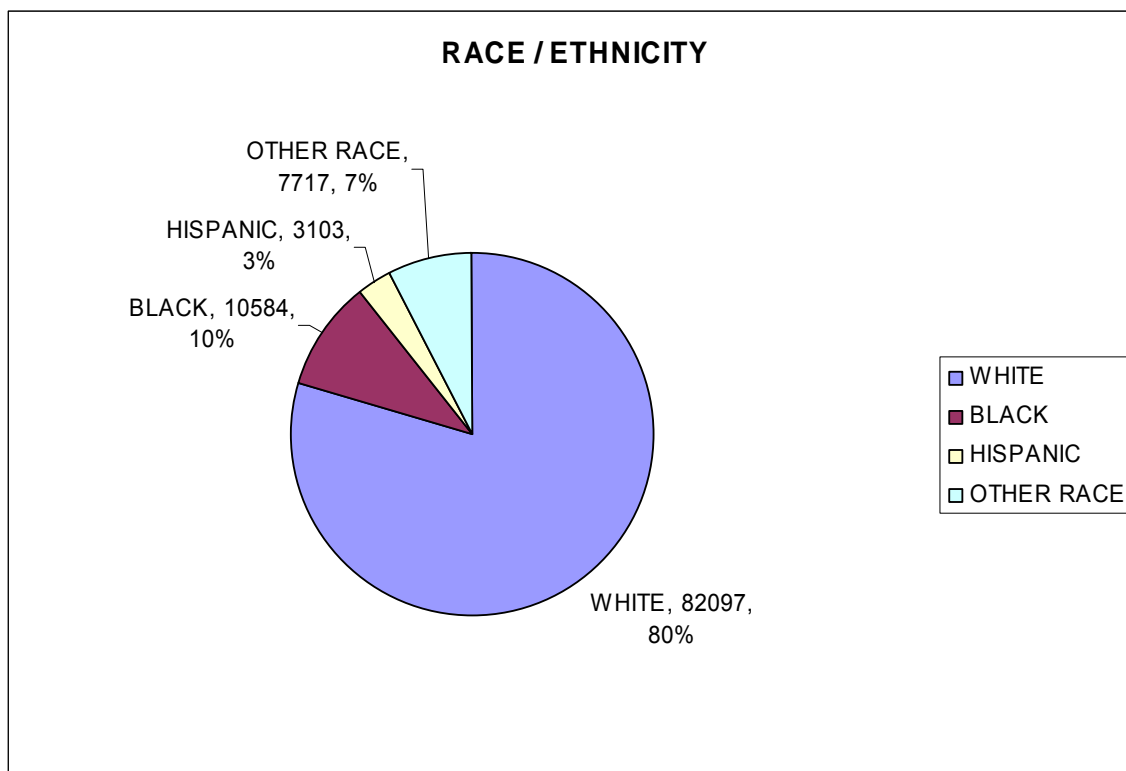
Figure 17.   Number of Officers by Race and Ethnicity

Table 5 shows the distribution of race and ethnicity by source of commission. White officers make up 88.70 percent of USMA graduates, the largest proportion that whites make up of any of the commissioning sources. The largest percentage of black officers is seen among OCS graduates (15.22%). ROTC non-scholar graduates have the largest percentage of Hispanic officers (4.42%).

Table 5.   Commissioning Source by Race/Ethnicity Group

	WHITE %	BLACK %	HISPANIC %	OTHER %	TOTAL %
USMA	88.70	4.92	1.82	4.57	100.00
ROTC (SCHOLAR)	80.07	8.80	2.51	8.61	100.00
ROTC (NONSCHOLAR)	74.61	14.47	4.42	6.51	100.00
OCS	75.67	15.22	3.96	5.15	100.00
DIRECT APPOINTMENT	77.86	8.50	2.01	11.63	100.00

Figure 18 provides information about the gender of the officers in all of the cohorts. Females make up 18 percent of the commissioned officers while males make up 82 percent.

81

GENDER

FEMALE, 18768, 18%

MALE, 84733, 82%
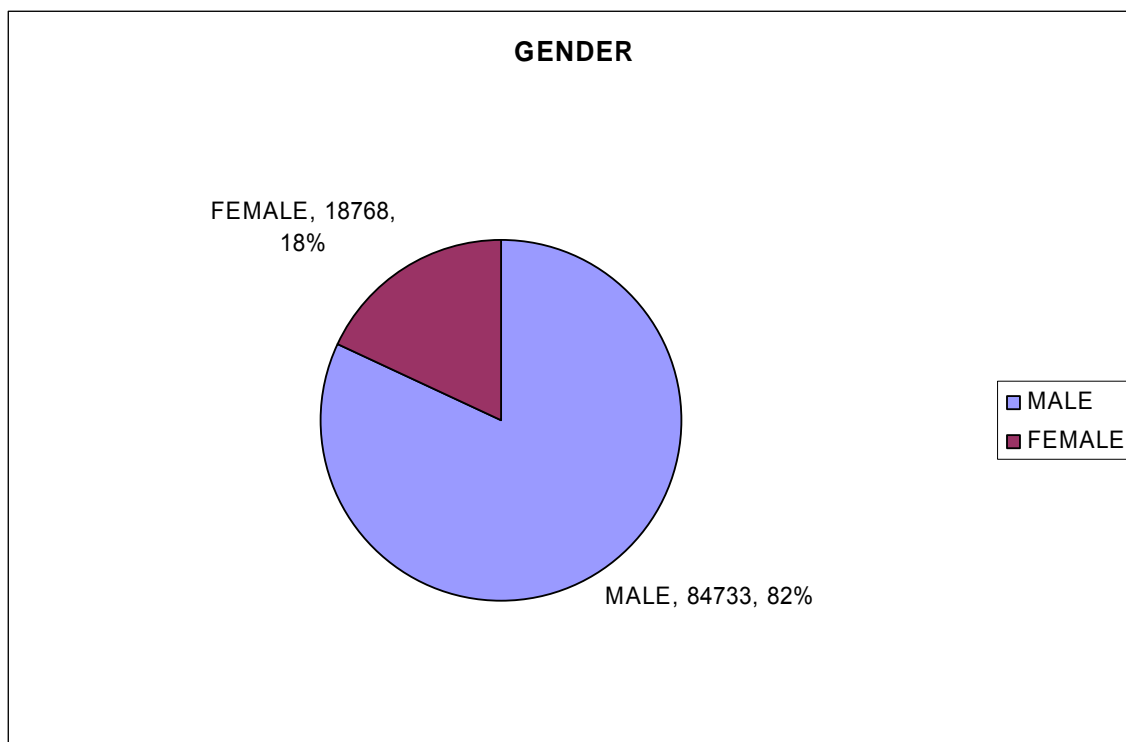
- MALE
- FEMALE

Figure 18.   Number of Officers by Gender

Table 6 shows the percentage of male and female officers by commissioning source. The highest male percentage is among the USMA graduates whereas the highest female percentage is among officers commissioned through direct commissioning.

Table 6.   Commissioning Source by Gender

	MALE	% MALE	FEMALE	% FEMALE	TOTAL
USMA	17652	90.95	1756	9.05	19408
ROTC (SCHOLAR)	22281	79.48	5753	20.52	28034
ROTC (NONSCHOLAR)	28028	85.07	4918	14.93	32946
OCS	5611	87.49	802	12.51	6413
DIRECT APPOINTMENT	11161	66.83	5539	33.17	16700
TOTAL	84733		18768		103501

Figure 19 represents information about the marital status of the officers. Marital status is measured at the last available record year for the officer. As seen in the figure, 66 percent of the commissioned officers are married and 34 percent are single.

MARITAL STATUS

SINGLE, 35091, 34%

MARRIED, 68410, 66%

- MARRIED
- SINGLE
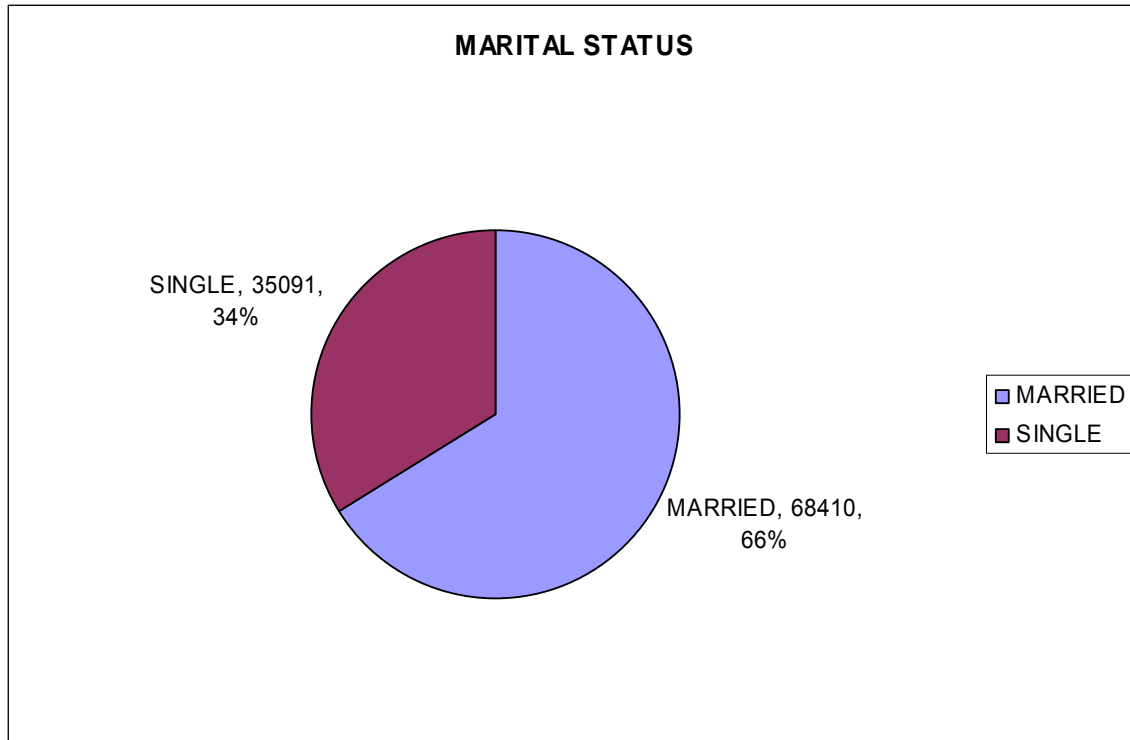
Figure 19.   Number of Officers by Marital Status

Table 7 shows information about the marital status of the officers by their commissioning sources. Marital status is measured at the last available record year for the officer. It can be seen in the table that the highest percent married is among the OCS graduates (74.54 percent). The highest percent single is among the ROTC Scholarship (39.45 percent) graduates.

Table 7.   Commissioning Source by Family Status

	MARRIED %	SINGLE %	TOTAL %
USMA	61.46	38.54	100.00
ROTC (SCHOLAR)	60.55	39.45	100.00
ROTC (NONSCHOLAR)	68.96	31.04	100.00
OCS	74.54	25.46	100.00
DIRECT APPOINTMENT	71.90	28.10	100.00

Figure 20 shows the number of non-spousal dependents of officers. The variable is measured at the last available record year for the officer. The largest group of officers has no non-spousal dependents, making up 46% of the data set.

NUMBER OF NON-SPOUSAL DEPENDENTS

1470, 1%

3810, 4%

10860, 10%

18288, 18%

47200, 46%

21873, 21%

Legend:
- 0
- 1
- 2
- 3
- 4
- 5 AND MORE
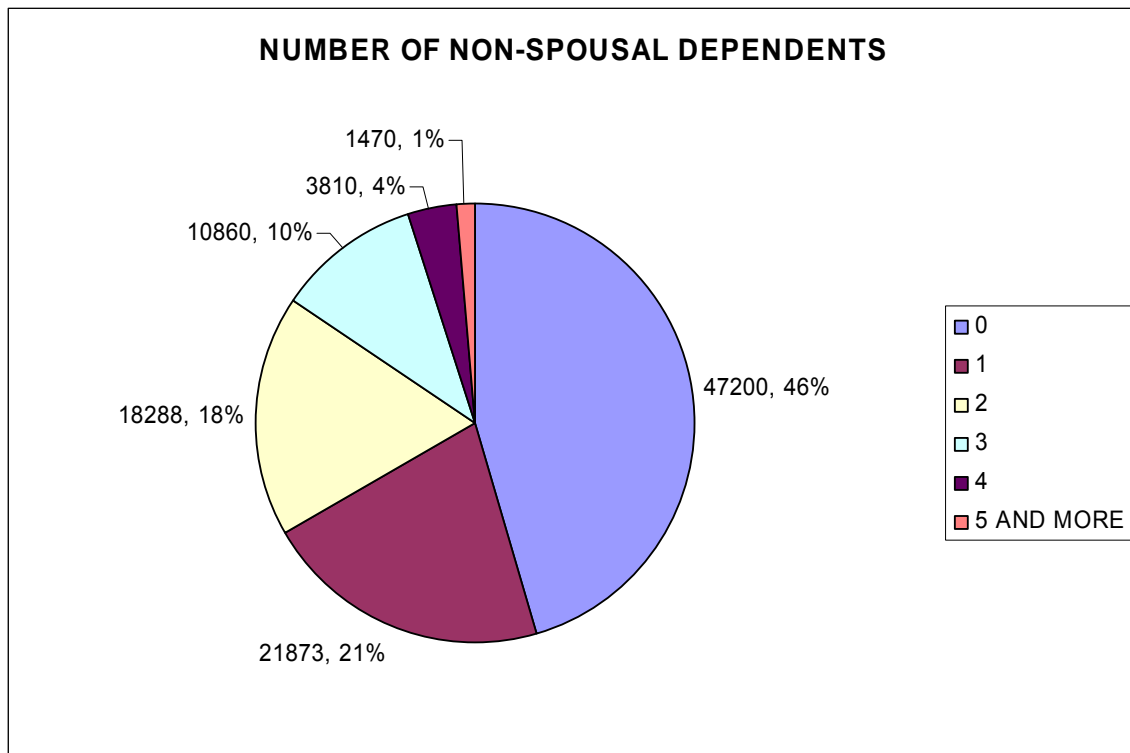
Figure 20.   Number of Officers by Non-Spousal Dependents

The military occupation variables used in this study are Aviation, Infantry, Armor, Cavalry, Field Artillery, Air Defense Artillery, Intelligence, Engineering, Special, Administrative, Military Police, Supply, Transportation, and Other occupations. However, because of data limitations, only one variable (IACF) is generated for Infantry, Armor, Cavalry, and Field Artillery branches. Aggregation is used to form the military occupation categories: Combat Arms, Combat Support, Combat Service Support, and Special Branch Groups. The largest group among these four is the Combat Arms group with 55,814 officers (54%). The numbers of officers in Combat Support, Combat Service Support, and Special Branch Groups are 7,217 (7%), 11,451 (11%) and 29,019 (28%), respectively. Figure 21 and figure 22 show the numbers of officers by occupational group and aggregated occupational category.
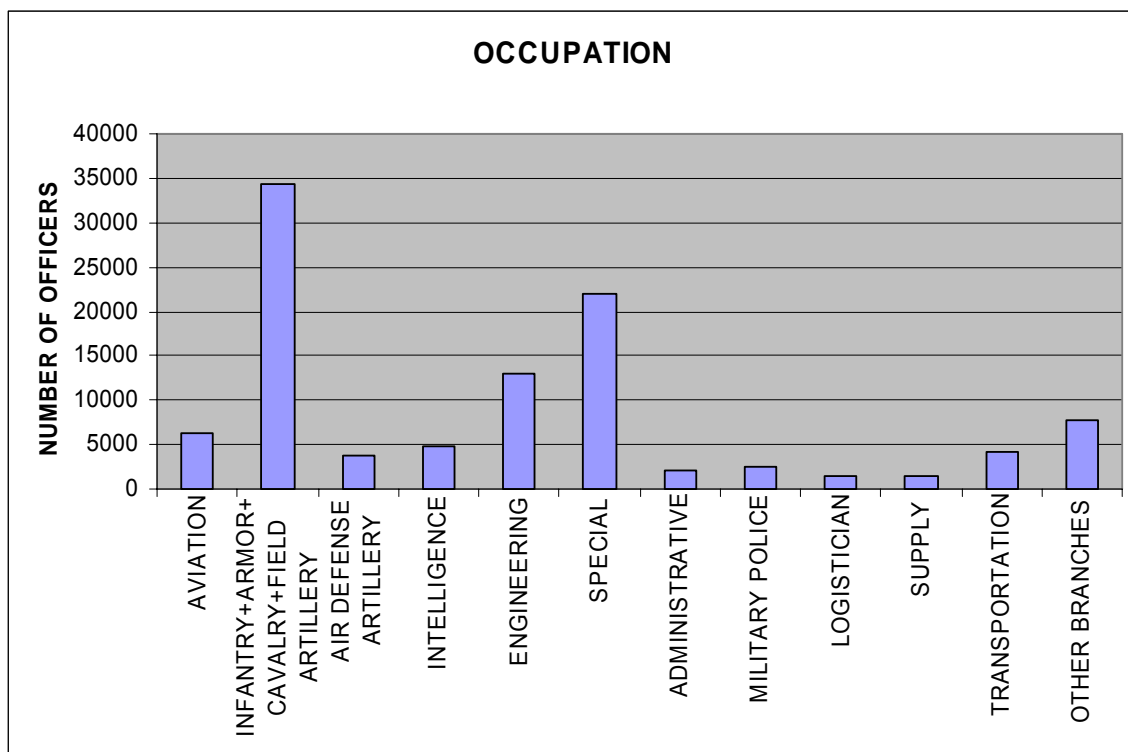
Figure 21.   Number of Officers by Occupation
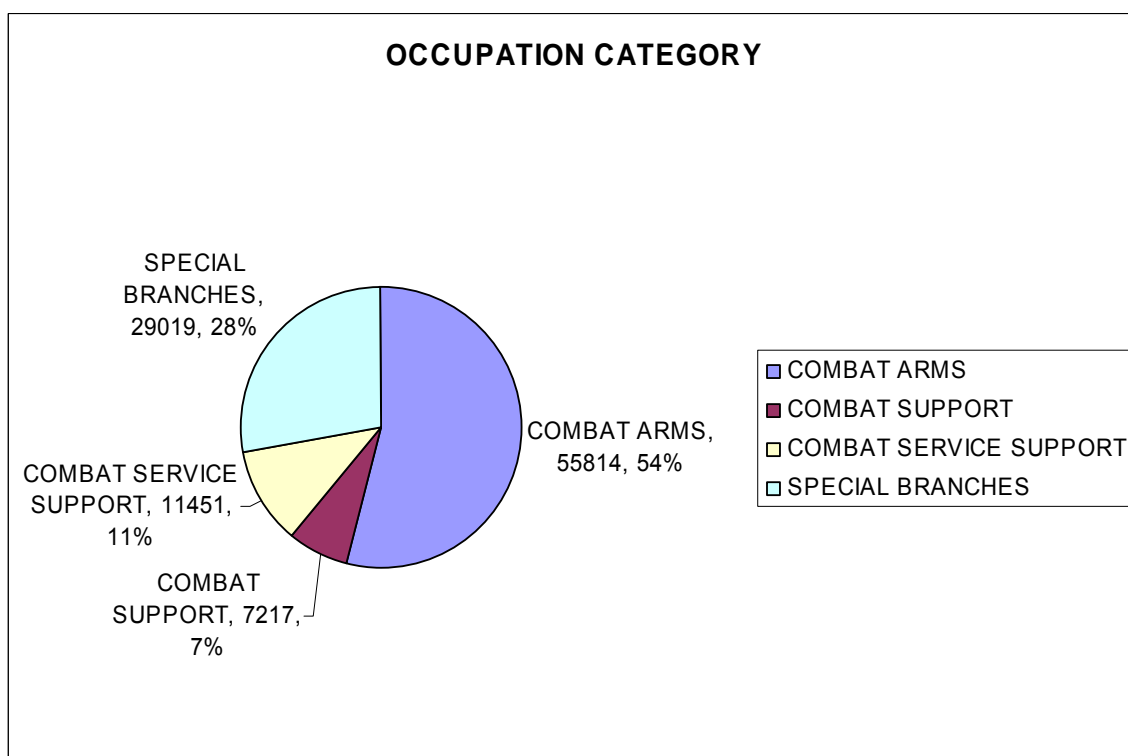
Figure 22.   Number of Officers by Occupation Category

Table 8 and Table 9 show the numbers of officers in occupations and the occupation categories by commissioning source respectively. As seen in the table, the Infantry + Armor + Cavalry + Field Artillery occupation makes up the largest group among all of the sources except for Direct Appointment. The same is true for the Combat Arms occupation category as seen in table 9.

Table 8.   Commissioning Source by Occupation

	ACADEMY	ROTC (Scholarship)	ROTC (Non-Scholarship)	OCS	DIR. APP.
AVIATION	11.42%	4.79%	7.39%	2.09%	0.50%
INFANTRY+ARMOR+ CAVALRY+FIELD ARTILLERY	50.33%	31.47%	37.84%	46.28%	2.44%
AIR DEFENSE ARTILLERY	4.53%	3.87%	4.12%	5.52%	0.08%
INTELLIGENCE	4.29%	5.68%	5.28%	8.03%	0.43%
ENGINEERING	11.92%	17.25%	14.12%	15.56%	1.60%
SPECIAL	1.54%	15.80%	10.28%	2.46%	81.81%
ADMINISTRATIVE	1.57%	2.63%	2.28%	4.13%	0.39%
MILITARY POLICE	1.90%	2.56%	3.24%	3.87%	0.38%
LOGISTICIAN	1.49%	1.73%	1.97%	1.82%	0.07%
SUPPLY	0.59%	1.93%	1.96%	2.78%	0.10%
TRANSPORTATION	2.30%	5.50%	5.12%	6.03%	0.32%
OTHER BRANCHES	8.11%	6.80%	6.39%	1.42%	11.87%
TOTAL	100.00%	100.00%	100.00%	100.00%	100.00%

Table 9.   Commissioning Source by Occupation Category

	ACADEMY	ROTC (Scholar)	ROTC (Non-Scholar)	OCS	DIR. APP.
COMBAT ARMS	76.90%	55.29%	61.52%	67.96%	4.57%
COMBAT SUPPORT	6.19%	8.23%	8.52%	11.90%	0.81%
COMBAT SERV. SUP.	7.25%	14.51%	13.90%	16.36%	2.08%
SPECIAL BRANCHES	9.65%	21.97%	16.06%	3.79%	92.53%
TOTAL	100.00%	100.00%	100.00%	100.00%	100.00%

Figure 23 represents the number of officers by prior enlistment status. Among the cohort groups, the number of officers who are prior enlisted is 29,526 (29%).

PRIOR ENLISTED STATUS

PRIOR ENLISTED, 29526, 29%

NOT PRIOR ENLISTED, 73975, 71%

- ☐ PRIOR ENLISTED
- ■ NOT PRIOR ENLISTED
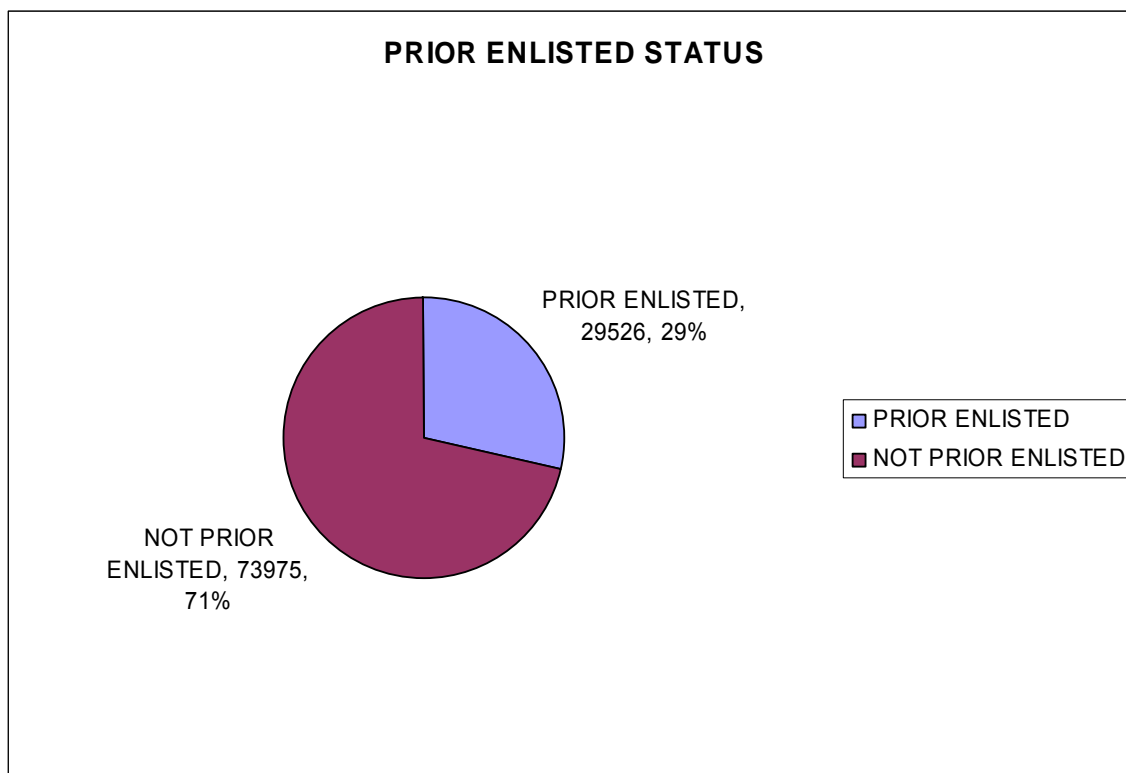
Figure 23.   Number of Officers by Prior Enlistment Status

Table 10 and Figure 24 present information about prior enlisted status of officers by their commissioning sources. Table 10 shows the number of the prior enlisted officer by their sources of commission while Figure 24 shows the percentages. As seen in figure 13, 41 percent of the ROTC Non-Scholarship graduates are prior enlisted. The percentage of the prior enlisted officers among Direct Commissioning officers is 20 percent. The percentages of prior enlisted officers among ROTC Scholarship, OCS and USMA graduates are 18, 16 and five percent, respectively.

Table 10.   Number of Prior Enlisted Officers by Commissioning Source

	PRIOR ENLISTED
USMA	1397
ROTC (SCHOLAR)	5187
ROTC (NONSCHOLAR)	12170
OCS	4868
DIRECT APPOINTMENT	5904
TOTAL	29526

PRIOR ENLISTED STATUS

USMA, 1397, 5%

ROTC (SCHOLAR), 5187, 18%

DIRECT APPOINTMENT, 5904, 20%

OCS, 4868, 16%

ROTC (NONSCHOLAR), 12170, 41%

Legend:
- USMA
- ROTC (SCHOLAR)
- ROTC (NONSCHOLAR)
- OCS
- DIRECT APPOINTMENT
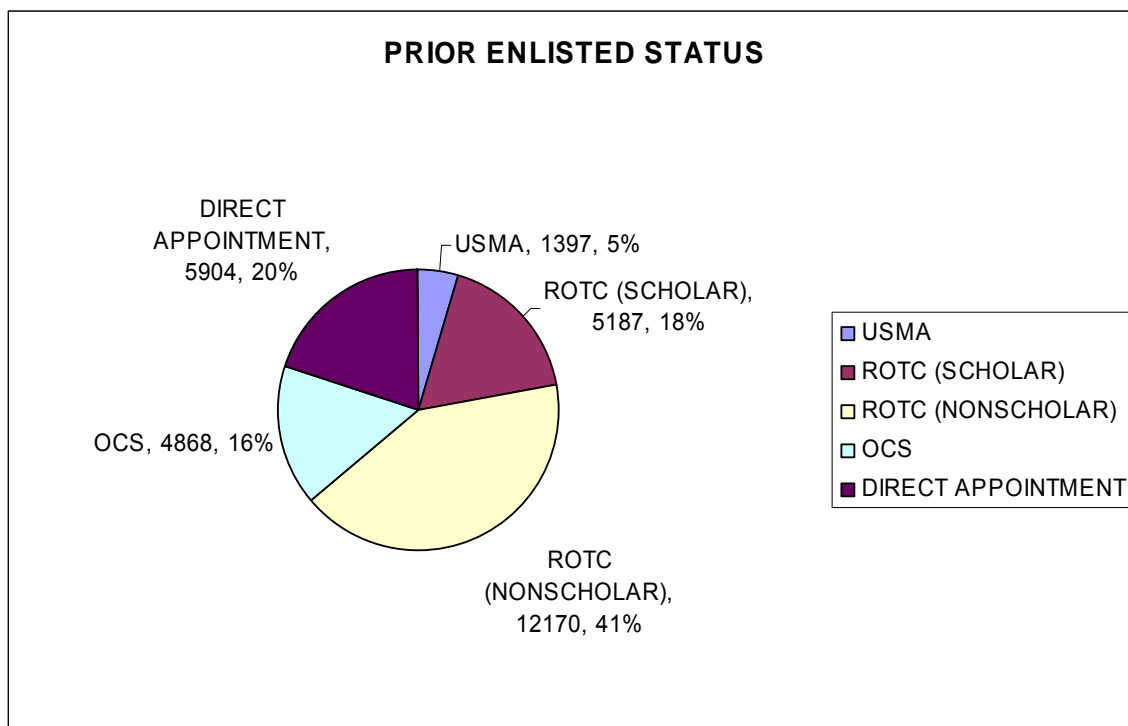
Figure 24.   Percentage of Prior Enlisted Officers by Commissioning Source

Figure 25 shows the percentage of officers who obtained graduate degrees. The graduate education variable is measured at the last available record year for the officer. Eighteen percent (18,374) of the commissioned Army officers in the data set have graduate degrees.

GRADUATE EDUCATION STATUS

YES, 18374, 18%

NO, 85127, 82%

- YES
- NO
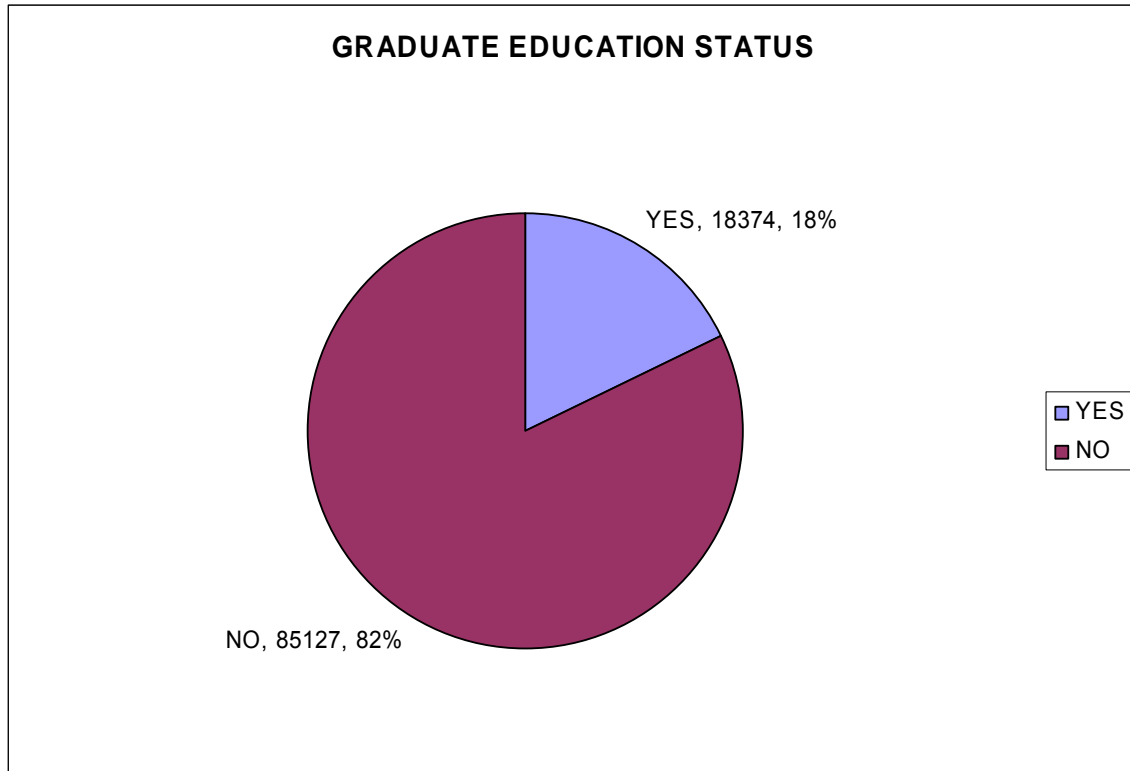
Figure 25.   Number and Percent of Army Officers with Graduate Degrees

Table 11 represents the number of the officers who have graduate education from each source. When compared to other sources, ROTC Non-Scholarship graduates have the highest percentage with 19.61 percent. The percentage of the ROTC Scholarship graduates who have a graduate education is 14.50 percent, which is the lowest among all the sources.

Table 11.   Percentage of the Officers who have Graduate Education

	OFFICERS WHO OBTAINED GRADUATE DEGREES	TOTAL NUMBER OF OFFICERS	PERCENTAGE
USMA	3660	19408	18.86%
ROTC (SCHOLAR)	4064	28034	14.50%
ROTC (NONSCHOLAR)	6461	32946	19.61%
OCS	1165	6413	18.17%
DIRECT APPOINTMENT	3024	16700	18.11%

C.   DATA LIMITATIONS

The data used in this study has some limitations which may decrease the reliability of the results. First of all, this study focuses on the commissioning sources of the Army officers. Therefore, commissioning source variables are very important. However, the commissioning source of almost 22,000 officers in the data set is coded as "unknown." There are also almost 800 observations whose commissioning source is different from the ones discussed in this study. Since there is no additional information about the sources of these officers, their commissioning source is also treated as "unknown." Therefore these observations were deleted from the data set.

Second, the variables in the original data that represent separation age, entry age, years of commissioning service, date of separation, and date of entry are not entirely reliable. Because the duration variable is very important in survival analysis, a new variable, N_ARMY, was generated for duration. N_ARMY is the length of service for officers, in years, and it is generated by counting the valid pay grades for every officer. However, sometimes there is a gap in yearly pay grades that may be a result of lost data or because the officer left the service and then returned. Therefore, a binary variable was used to represent this gap. If this binary variable is 1, then the observation was deleted.

Finally, in the data set, it was not possible to distinguish between infantry, cavalry, armor, and field artillery officers. Therefore, a single variable (IACF) was used for these four occupational specialties.

Some of the explanatory variables have some missing data. The observations that have missing values for any of the explanatory variables were deleted from the data set

VII. RESULTS OF SURVIVAL ANALYSIS

In this study, three SAS procedures were used to analyze the survival of Army officers. These procedures are PROC LIFETEST, PROC LIFEREG and PROC PHREG. This chapter presents the results of these three survival procedures.

PROC LIFETEST is useful for preliminary survival data. It tests hypotheses about differences across groups.[116] PROC LIFEREG uses several different probability distributions to model survival time. Regression models are estimated using maximum likelihood methods.[117] PROC PHREG doesn't impose a particular probability distribution.[118] It uses a maximum partial likelihood method and a proportional hazards model to estimate the hazard of separation.

A. ESTIMATING AND COMPARING SURVIVAL CURVES WITH PROC LIFETEST

PROC LIFETEST produces descriptive information about the data used in the study. It allows a comparison of the survival curves of different groups[119] and generates life-table survival and hazard estimates. PROC LIFETEST uses two methods, the Kaplan–Meier Method and the Life-Table Method for the survivor function. The Kaplan-Meier Method is also known as the product-limit estimator. It is the most widely used method in biomedicine. It is suitable for small data sets. The Life-Table Method is preferred when the number of observations is large and event times are measured precisely. Since event times are grouped in the Life-Table Method, it doesn't produce long tables as the Kaplan-Meier Method does. The Life-Table Method can also produce estimates and plots of the hazard function which are not available in PROC LIFETEST with the Kaplan-Meier Method.[120]

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[116] Paul D. Allison, *Survival Analysis*, 59.

[117] Ibid, 61.

[118] Ibid, 183.

[119] Ibid, 29.

[120] Ibid, 30-41.

Table 12 presents the Kaplan-Meier estimates for the service time of 103,501 officers in the data set. Of these 103,501 officers, 40,507 were censored. These 40,507 officers make up the 39.14% of the whole data set.

Table 12.   Kaplan Meier Estimates for Service Time

PROBABLITY OF LEAVING	POINT ESTIMATE (YEARS OF SERVICE)
0.75	20
0.50	8
0.25	4

The table shows that the probability of leaving the service is greater than .25 after 4 years of commissioned service. The point estimate for .50 is the median service time. Median service time is 8 years and the probability of leaving the service is greater than .75 after 20 years of commissioned service.

PROC LIFETEST also reports a mean service time. For all of the officers, the mean service time is 11.16 years with a standard error of 0.0274. For censored survival data, the median is preferred to the mean when measuring central tendency. There are two reasons of this preference. First, censoring times greater than the largest event time may bias the mean. Second, the presence of a substantial number of censored observations affects the estimates of the mean. For these reasons, 8 years represents the central tendency better than 11.16 years in this case.

PROC LIFETEST generates a plot of the estimated survival function using the Kaplan-Meier and Life-Table methods. The Kaplan-Meier Method is suitable for small datasets whereas the Life-Table Method is better for large data sets. The following two figures show the survival function of 103,501 officers who were commissioned from 1981 through 2001. Figure 26 is generated using the Kaplan-Meier Method and Figure 27 is generated using the Life-table Method.

As seen in both figures, the estimated survival function of officers is not very steep until the fourth year of service, which is the end of obligated time of service for most officers (except for the aviators). After the fourth year it falls steeply until the 12th - 13th years. This is the promotion point to Major. After the 12th-13th years, officers who are promoted to Major and stay in the military do not tend to leave the service. That is why the estimated survival function is almost horizontal from this point to the 20th year. The twentieth year is the time of retirement eligibility so we observe a decline in the survival curve at the 20th year.
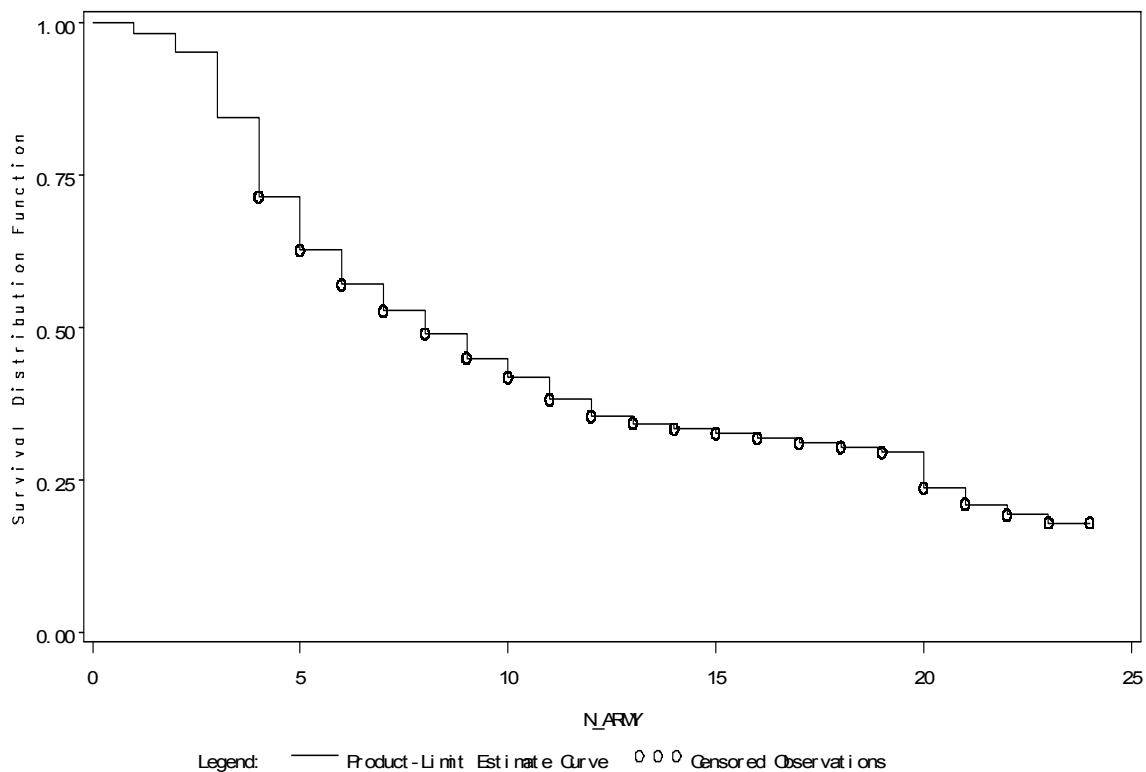
Figure 26.   Survival Function of officers commissioned from 1981 through 2001
(Kaplan-Meier Method)
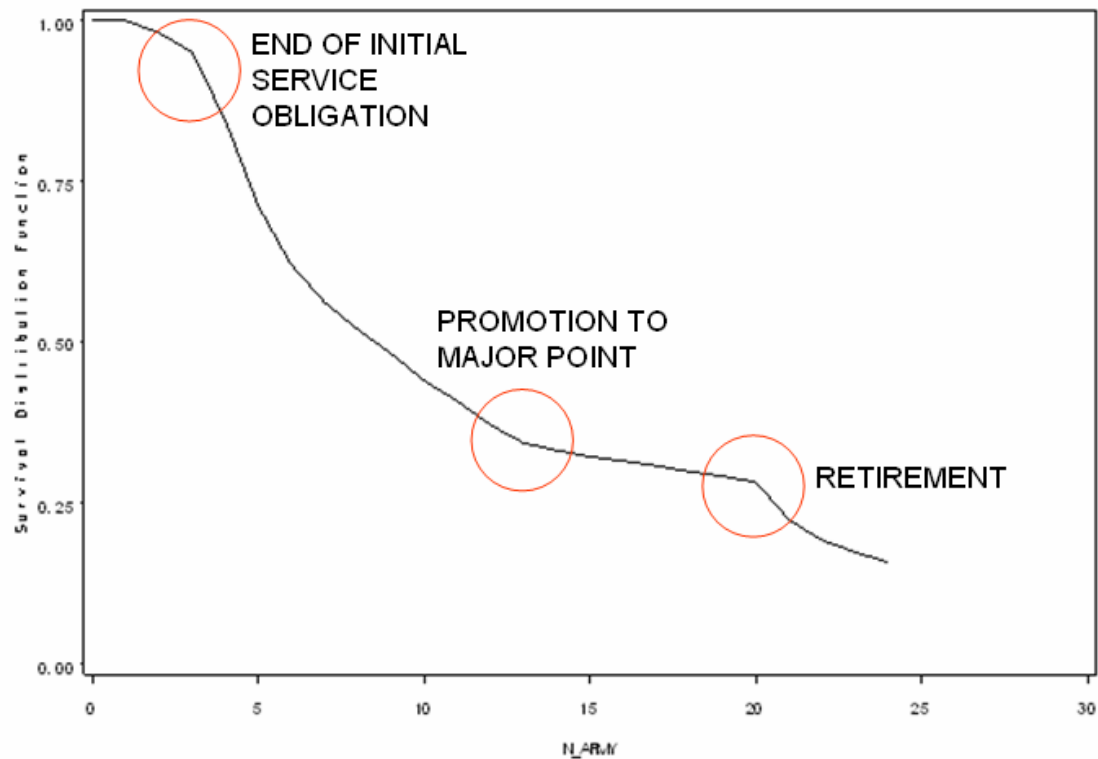
Figure 27.   Survival Function of officers commissioned from 1981 through 2001
(Life-Table Method)

Figure 28 represents the hazard function for the Army officers in the data set. As seen in the figure, there is a rapid decline in the hazard of leaving the service after the end of the initial service obligation at about four years. The hazard function falls after the end of the initial obligation. There is again a decline in the hazard after the promotion to Major point. Then the hazard falls and remains stable until the 20th year of service. At the 20th year, there is a rapid increase in the hazard due to retirement. After the 20th year a rapid decline is seen in the hazard of leaving the service.
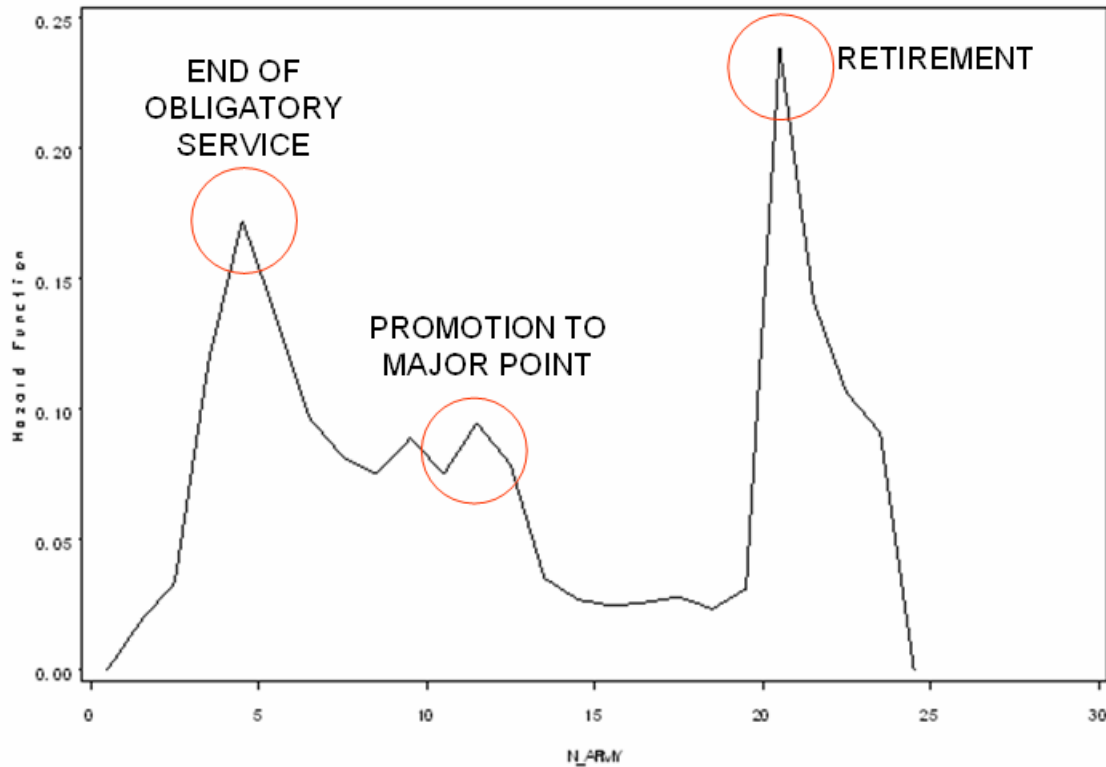
Figure 28.   Hazard Function of officers commissioned from 1981 through 2001 (Life-Table Method)

Table 13 shows the life table survival estimates for the officers in five-year intervals. The statistics reported in the table include the number of failed (separated) and censored observations. In this method, the censored observations are treated as if they were censored at the midpoint of each interval. Therefore, when calculating the effective sample size, since censored observations are at risk for half of the intervals, they count for half in figuring the effective sample size. For example, the effective sample size for the first interval is 103,501 minus half of the 4,337 censored observations (which is 2,168.5 observations). Thus the effective sample size is 101,332.5. The conditional probability of failure in table 13 shows the probability that an officer will leave the service in the interval, given that he or she made it to the start of the interval. For example, the probability that an officer will leave the service in the second interval (between five and ten years), given that he was in service at the beginning of the fifth year, is 0.29. PROC LIFETEST also gives an estimate of the standard error of the

conditional probability. The survival column in table 13 shows the probability that an event occurs at a time greater than or equal to the beginning of each interval. For example, the survival column for the second interval indicates that the probability that an officer will not leave the service until year five is 0.70. The failure column is calculated by subtracting survival from one. This column shows the probability of failure at a time greater than or equal to the beginning of each interval. Survival standard errors are also given in the table. The median residual lifetime value shows the estimate of the remaining time until an event for a person who survived to the start of the interval. For example, for an officer who is in the service at the beginning of the fifth year, the estimate of the remaining time in service is 8.63 years. The standard errors are also reported. The PDF column in table 13 shows the estimate of the probability density function at the midpoint of each interval whereas the hazard column shows the estimate of the hazard function at the midpoint of each interval. Standard errors for probability density and hazard functions are also reported.[121]

Table 13.   Life-Table Survival Estimates

LOWER INTERV.	HIGHER INTERV.	NUM. FAILED	NUM. CENS.	EFF. SAMPLE SIZE	COND. PROB. OF FAILURE	COND. PROB. STAND. ERROR	SURV.	FAIL.
0	5	29691	4337	101332.5	0.2930	0.00143	1	0
5	10	23313	15154	61896.0	0.3766	0.00195	0.7070	0.2930
10	15	7140	9489	26261.5	0.2719	0.00275	0.4407	0.5593
15	20	1224	8169	10292.0	0.1189	0.00319	0.3209	0.6791
20	25	1626	3358	3305.0	0.4920	0.00870	0.2827	0.7173

Table 13.   Life-Table Survival Estimates (Cont'd)

LOWER INTERV. (CONT'D)	HIGHER INTERV. (CONT'D)	SURV. STAND. ERROR	MEDIAN RESIDUAL LIFETIME	MEDIAN STAND. ERROR	PDF	PDF STAND. ERROR	HAZARD	HAZ. STAND. ERROR
0	5	0	8.8867	0.0295	0.0586	0.000286	0.068660	0.000393
5	10	0.00143	8.6392	0.0593	0.0533	0.000296	0.092807	0.000591
10	15	0.00164	-	-	0.0240	0.000258	0.062931	0.000735
15	20	0.00170	-	-	0.0076	0.000209	0.025288	0.000721
20	25	0.00181	-	-	0.0278	0.000523	0.130498	0.003059

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[121] Paul D. Allison, *Survival Analysis*, 43-46.

PROC LIFETEST tests whether the survival functions of two or more groups are identical or not. It generates a plot of the survival functions and calculates two statistics. These two statistics are the Log-Rank Test and the Wilcoxon Test. They are calculated to test the null hypothesis that there is no difference between the survival functions of the groups.

This study analyzes the effects of commissioning sources on the survival patterns of Army officers. Therefore, it is useful to look at the survival functions of the commissioning sources and see how their shapes compare. The following table shows the number of total, failed, and censored observations, the percentage of the censored observations, the Log-Rank statistic and the Wilcoxon statistic for each commissioning source in the Army.

Table 14.   Summary of the Observations and Test Statistics by Commissioning Source

COMMISSIONING SOURCE	TOTAL	FAILED	CENSORED	% CENSORED	LOG-RANK	WILCOXON TEST
USMA	19408	12048	7360	37.92	-283.5	-8.033E7
ROTCSCHOLAR	28034	16341	11693	41.71	681.9	70720571
ROTCNONSCHOLAR	32946	19738	13208	40.09	-1592.8	-7.574E7
OCS	6413	2721	3692	57.57	-980.4	-5.897E7
DIRAPPOINT	16700	12146	4554	27.27	2174.9	1.4432E8

The following null hypothesis is tested using PROC LIFETEST:

The null hypothesis for the two tests is:

H_0: The survival functions of different commissioning sources for Army Officers are the same.

The alternative hypothesis is:

H_1: The survival functions of different commissioning sources for Army Officers are not the same.

As shown in Table 15, the null hypothesis can be rejected at all the usual levels of significance. The survival functions of the different commissioning sources for Army

officers are not the same. Table 15 includes two alternative statistics for testing the null hypothesis that survivor functions are the same among the groups. These are the Log-Rank and the Wilcoxon tests. A third test, the likelihood-ratio test, is calculated assuming that the event times have an exponential distribution. The Wilcoxon test gives more weight to early times than late times. Therefore, the log-rank test is more sensitive than the Wilcoxon test to test differences between the groups that occur at later points in time. If the event times have log-normal distributions with a common variance but with different means, the Wilcoxon test is better than the Log-Rank test. However, when the survival curves cross, neither is good at detecting differences.[122]

Table 15.   Test Statistics for Testing the Differences among Commissioning Sources for Army Officers

TEST	CHI-SQUARE	DF	PR>CHI-SQUARE
LOG-RANK	992.8565	4	< .0001
WILCOXON	852.0294	4	< .0001
2LOG(LR)	909.4582	4	< .0001

PROC LIFETEST also produces plots for the survival functions. The following figures show the survival functions of the Army commissioning sources. Figure 29 uses the Kaplan-Meier method, whereas figure 30 uses the life-table method. Both of the figures indicate that USMA graduates have the highest survival curve until the fifth year of service after which it falls below some of the other sources. This is because USMA graduates have a five year active duty service obligation while the graduates of the other sources have a four year obligatory service period. After the sixth year of service, OCS graduates have the highest survival curve. The second highest survival curve belongs to the ROTC Non-Scholarship graduates. The survival curve of USMA graduates is higher than that of ROTC Scholarship graduates until the eighth year. However, after the eighth year, the opposite is true for the curves of these two commissioning sources. Thus, after the eighth year, ROTC Scholarship graduates have the third highest survival curve whereas USMA graduates' survival curve is the fourth highest. Except for the period

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[122] Paul D. Allison, *Survival Analysis*, 36-39.

between years five and 10 where the survival curve of the Direct Commissioning officers is slightly above ROTC Scholarship graduates, Direct Commissioning officers always have the lowest survival curve.
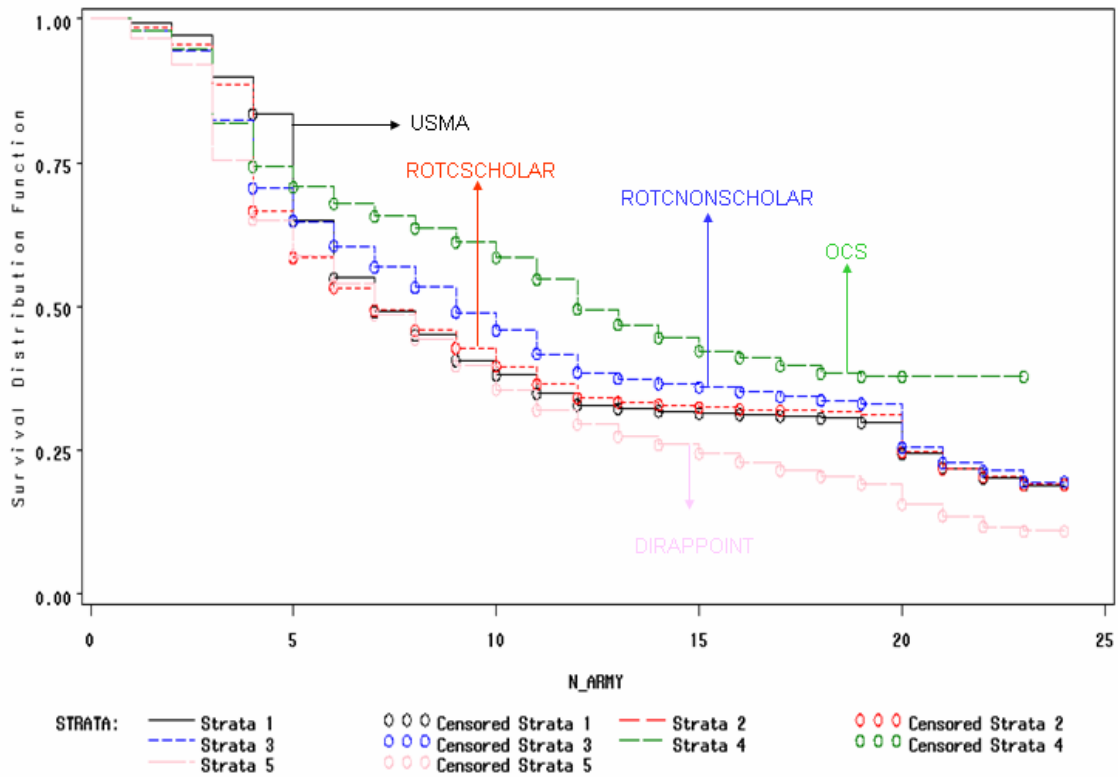
Figure 29.   Survival Functions of the Commissioning Sources of Army Officers
(Kaplan-Meier Method)
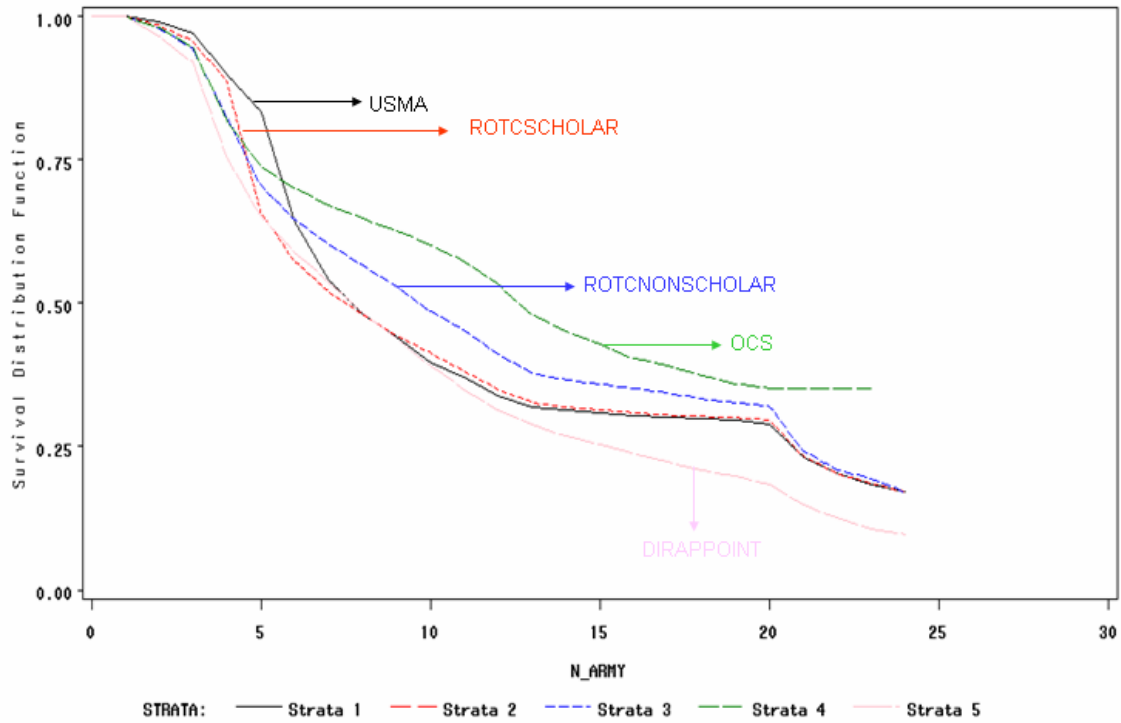
Figure 30. Survival Functions of the Commissioning Sources of Army Officers (Life-Table Method)

Table 16 presents the survival functions of the officers from different occupations in the Army and identifies the shape of the survival curve of each occupation. The table shows the number of total, failed, and censored observations, the percentage of censored observations, the Log-Rank statistic and the Wilcoxon statistic for each occupation in the Army.

Table 16. Summary of the Observations and Test Statistics by Occupation

BRANCH	TOTAL	FAILED	CENSORED	% CENSORED	LOG-RANK	WILCOXON
AVIATION	6211	3214	2997	48.25	-1223.8	-1.237E8
IACF	34432	19284	15148	43.99	-1963.1	-1.031E8
AIRDARTILLERY	3691	2285	1406	38.09	234.4	26198108
INTELLIGENCE	4752	3021	1731	36.43	129.8	3672262
ENGINEERING	13069	7823	5246	40.14	436.0	33574610
SPECIAL	21936	14415	7521	34.29	1819.4	1.2838E8
ADMINISTRATIVE	2123	1200	923	43.48	-5.1	716075
MILPOLICE	2465	1351	1114	45.19	-163.8	-1.003E7
LOGISTICIAN	1551	812	739	47.65	19.5	2390690
SUPPLY	1496	899	597	39.91	46.0	8621386
TRANSPORTATION	4116	2369	1747	42.44	62.7	12799419
OTHERMO	7659	6321	1338	17.47	608.1	20454214

Table 17 shows the results of a test of the following null hypothesis:

Table 17 tests the null hypothesis:

H_0: The survival functions of different occupations in the Army are the same.

Table 17 tests the alternative hypothesis:

H_1: The survival functions of different occupations in the Army are not the same.

The probabilities associated with the test statistics show that the null hypothesis can be rejected and that the survival functions of different occupations in the Army are not the same.

Table 17.   Test Statistics for Testing the Differences among Occupations for Army Officers

TEST	CHI-SQUARE	DF	PR > CHI-SQUARE
LOG-RANK	1034.9618	11	< .0001
WILCOXON	1266.4396	11	< .0001
-2LOG (LR)	9112904	11	< .0001

Figures 31 and 32 show the plot of the survival functions of different occupations in the Army. Figure 31 uses the Kaplan-Meier method, whereas figure 32 uses the life-table method. Both of the figures indicate that aviators have the highest survival curve for all of the times until the 21st year of service, which is because their obligatory service time is longer than that of all of the other occupations. Another factor about aviators is that they have many job opportunities in the civilian labor market. These job opportunities may result in a decline in the survival curve at the end of obligatory service. In this study there is a decline in the survival curve of the aviators between the sixth and the eighth years, however it is a slight decline. Among occupations other than aviation, the intelligence occupation has the highest survival curve until the fifth year. After the fifth year, the military police occupation has the highest curve until the 17th year. The survival curve of IACF (Infantry + Armor + Cavalry + Field Artillery) officers is slightly below than that of military police officers during these years. Between the 17th and the

20th years, IACF occupations have the highest survival curve. After the 21st year, the air defense artillery occupation has the highest survival curve among all of the occupations including aviation.
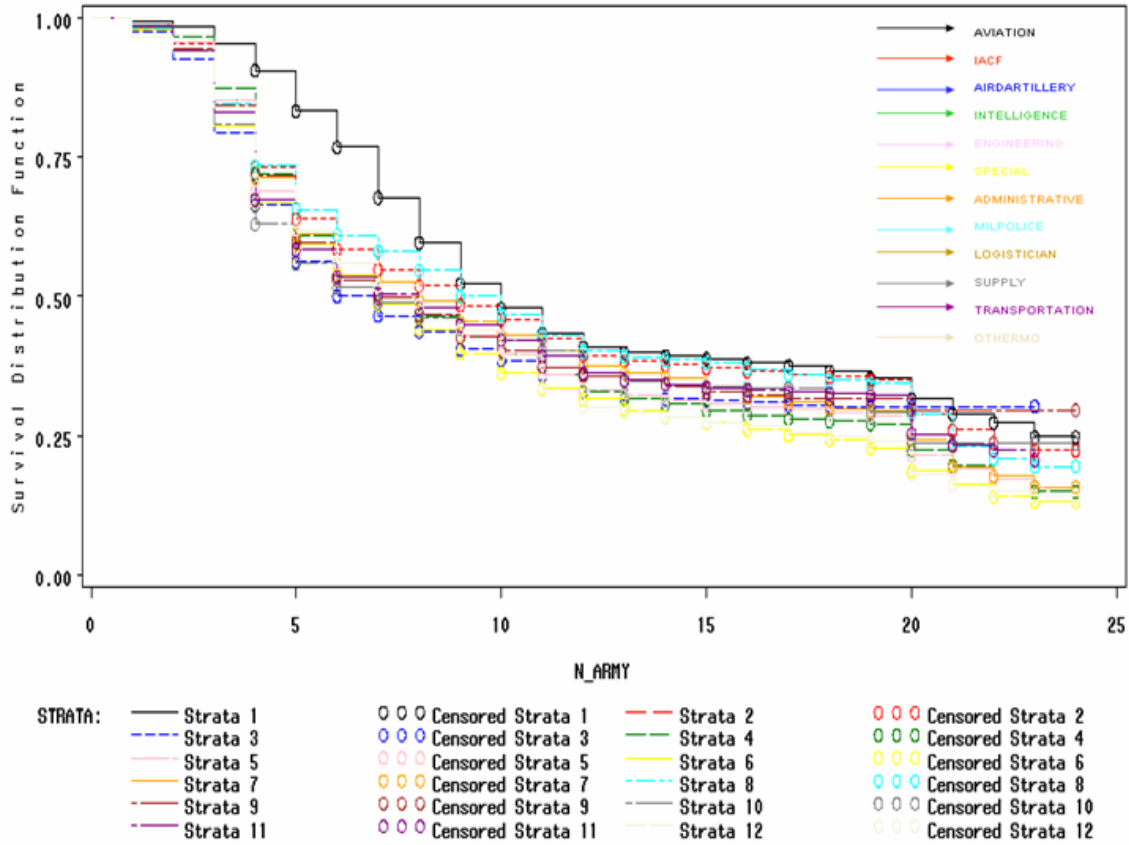
Figure 31.   Survival Functions of Different Army Occupations (Kaplan-Meier Method)
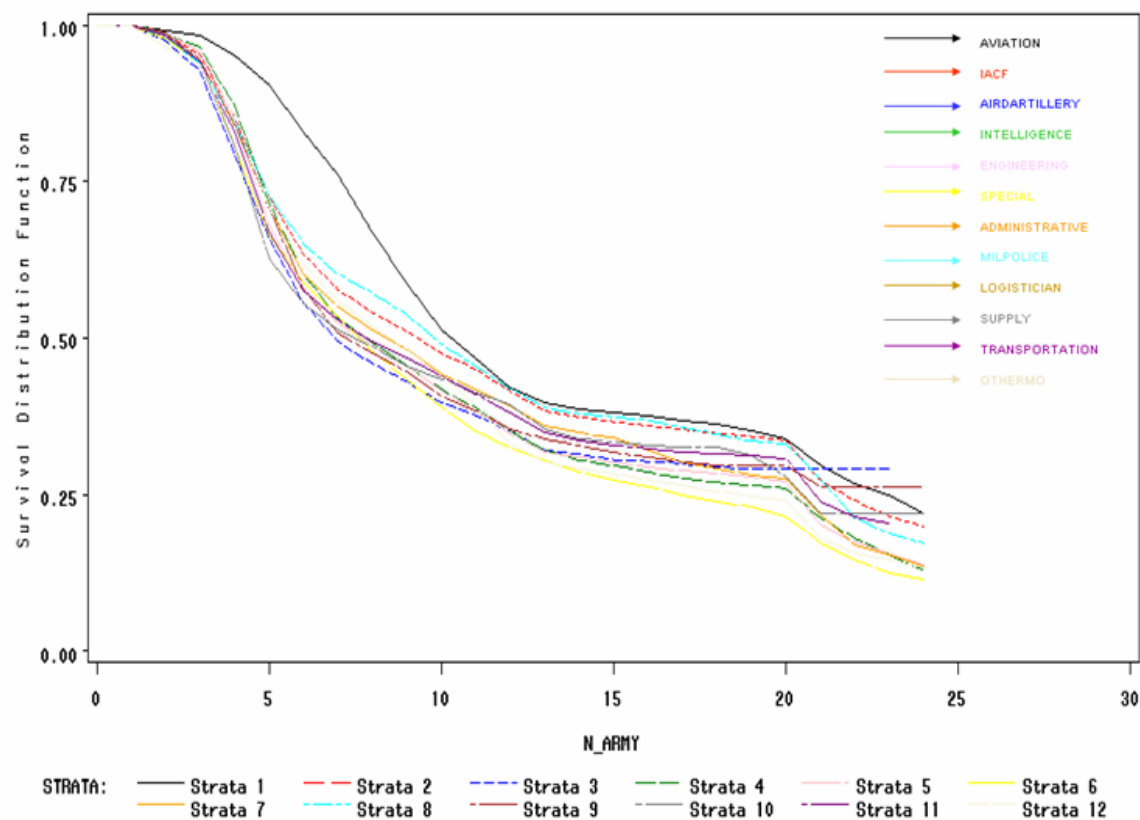
Figure 32.   Survival Functions of Different Army Occupations (Life-Table Method)

The survival functions of four aggregate occupational categories were also constructed. Table 18 shows the number of total, failed, and censored observations, the percentage of censored observations, the Log-Rank statistic and the Wilcoxon statistic for each occupational category.

Table 18.   Summary of the Observations and Test Statistics by Occupation Category

OCCUPATION CATEGORY	TOTAL	FAILED	CENSORED	% CENSORED	LOG-RANK	WILCOXON
COMBATARMS	55814	31750	24064	43.11	-2561.5	-1.715E8
COMBATSUPPORT	7217	4372	2845	39.42	-34.1	-6358246
COMBATSERVICE SUPPORT	11451	6579	4872	42.55	123.4	24154447
SPECIALBRANCHES	29019	20293	8726	30.07	2472.2	1.5366E8

Table 19 shows the results of a test of the following null hypothesis:

H_0: The survival functions of different occupational categories in the Army are the same.

H_1: The survival functions of different occupational categories in the Army are not the same.

The probabilities associated with the test statistics show that the null hypothesis can be rejected and that the survival functions of different occupations in the Army are not the same.

Table 19.   Test Statistics for Testing the Differences among Occupation Categories for Army Officers

TEST	CHI-SQUARE	DF	PR > CHI-SQUARE
LOG-RANK	600.6142	3	< .0001
WILCOXON	473.3208	3	< .0001
-2LOG (LR)	496.9552	3	< .0001

Figures 33 and 34 show the plot of the survival functions of different Army occupational categories. The first figure uses the Kaplan-Meier method, whereas the second one uses the life-table method. Both of the figures indicate that the combat arms occupational category has the highest survival curve for all of the times. This is expected because officers in the combat arms occupation category do not have many job opportunities in the civilian labor market. Until the 11th year of service, the second highest survival curve belongs to the combat service support occupational category. After the 11th year, the special branches category has the second highest survival curve. The combat support occupation group has the lowest survival curve for all of the times.
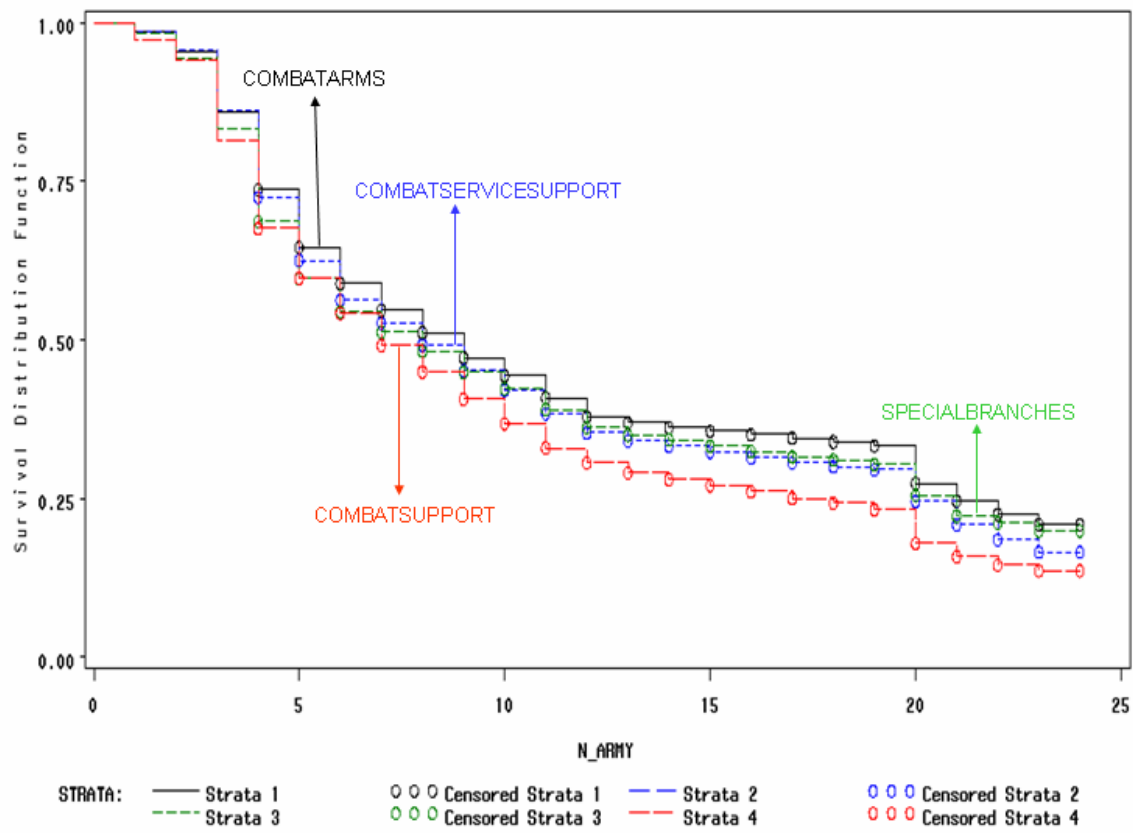
Figure 33.   Survival Functions of the Officers in Different Army Occupation
Categories (Kaplan-Meier Method)
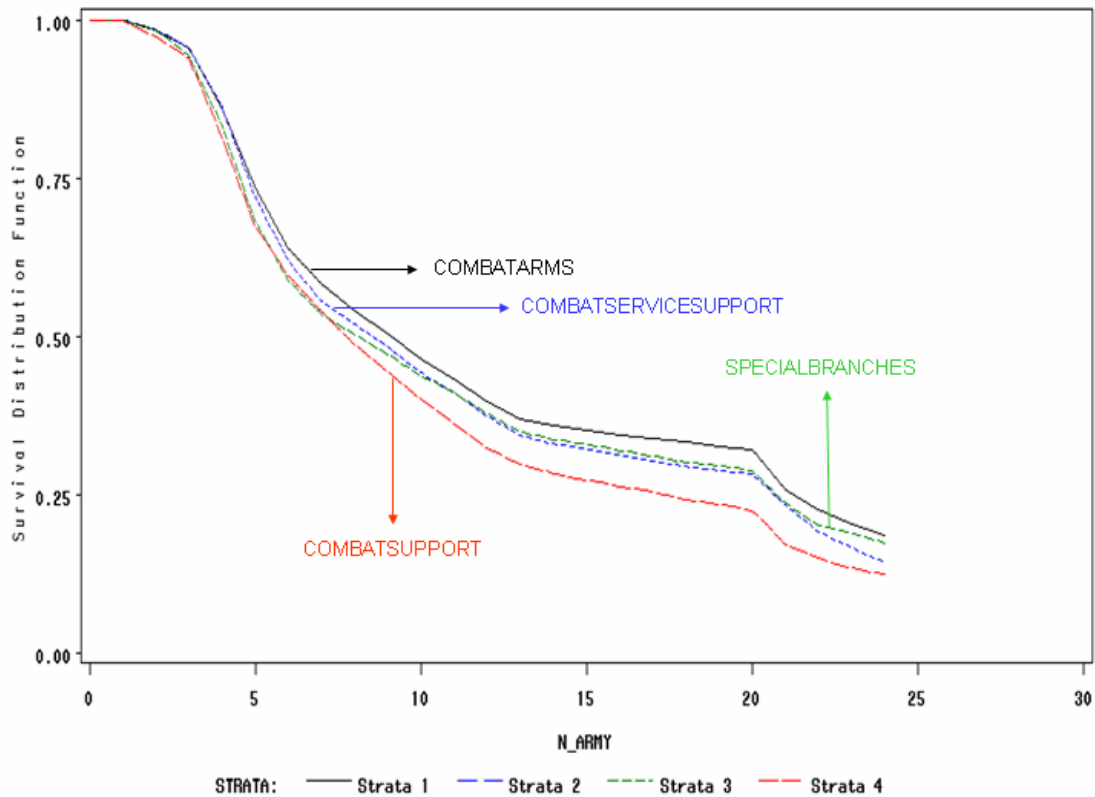
Figure 34.   Survival Functions of the Officers in Different Army Occupation
Categories (Life-Table Method)

B.   ESTIMATING PARAMETRIC REGRESSION MODELS WITH PROC LIFEREG

PROC LIFEREG allows using five different distributions in survival analysis. These are the log-normal, exponential, Weibull, gamma and log-logistic distributions. The reason why these different alternatives are worth considering is because they may lead to substantively different interpretations of the hazard function.[123] In general, the results of the models that are based on these distributions are mostly similar. However, there are also some differences among the results. There are two different ways to decide which distribution is the best. One method is to look at the log-likelihoods for the models. A lower magnitude of the log-likelihood value means that the model fits better. The log-likelihoods for all of the models are discussed in this chapter. Another approach is to evaluate the model fit using a graphical method. For the graphical method, a plot of the

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[123] Paul D. Allison, *Survival Analysis*, 66.

survivor function is generated for each distribution. If the survivor function is a straight line with an origin at zero, it fits the best.[124] Plots for all the distributions are generated and compared in this chapter.

Two different models are specified for each distribution. The difference between these two models is the use of occupation variables or occupational category variables. In the first model, the AVIATION, IACF (Infantry, Armor, Cavalry and Field Artillery), AIRDARTILLERY, INTELLIGENCE, ENGINEERING, SPECIAL, ADMINISTRATIVE, MILPOLICE, LOGISTICIAN, SUPPLY, and TRANSPORTATION military occupational specialties are used to denote military occupation. In the second model, these occupation variables are aggregated into four occupational categories: COMBATARMS, COMBATSUPPORT, COMBATSERVICESUPPORT, and SPECIALBRANCHES. For the first model, IACF is the base case for occupation, whereas in the second model, the combat arms occupational category is used as the base case.

Table 20 presents the results of the occupation model. The coefficient and the Pr>Chi value of each variable is reported for all of the distributions. The signs of the coefficients show the direction of the relationship between the variable and the event. For example, the signs of the commissioning sources are all negative in the log-normal model. This means that, when compared to USMA graduates, officers from all of the other commissioning sources have shorter times of service. The positive coefficient for the variable BLACK indicates that black officers have longer service times than the white officers who are the base case for race and ethnicity.

It is not possible to interpret the numerical magnitudes of the coefficients directly. A conversion is needed in order to interpret them. For the binary variables such as FEMALE, e^{β} is calculated and used to determine the partial effect. As an example, the coefficient for the variable FEMALE is -0.08115 and $e^{-0.08115}$ is equal to 0.9220. Finally, the partial effect is calculated as 0.9220 minus 1, or -0.0780. This means that, controlling for the other covariates, the expected service time for a female commissioned officer is 7.80 percent shorter than that of a male commissioned officer, the base case. The

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[124] Paul D. Allison, *Survival Analysis*, 91.

conversion steps are slightly different for continuous variables. For the continuous variables, after taking e^β, it is subtracted from one, and then the result is multiplied by 100. This gives the percent increase in the expected survival time for each one-unit increase in the variable.[125] The coefficient of the variable AGE in the exponential model is 0.00274. The steps for interpreting this coefficient are as follows: $e^{0.00274}$ is equal to 1.0027438 and 1.0027438 minus one is equal to 0.0027438. Multiplying this number by 100, we obtain 0.27438. This indicates that each additional year of age at commissioning results in a 0.27 percent (approximately 0.25 month) increase in the service time of a commissioned Army officer, controlling for the other covariates.

Table 20.　　　Results of the PROC LIFEREG Procedure for the Occupation Model

VARIABLES	LNORMAL EST.	PR > CHI SQ	EXPONENTIAL EST.	PR > CHI SQ	WEIBULL EST.	PR > CHI SQ	GAMMA EST.	PR > CHI SQ	LLOGISTIC EST.	PR > CHI SQ
INTERCEPT	1.56221	<.0001	1.59312	<.0001	1.75445	<.0001	1.54272	<.0001	1.50341	<.0001
AGE	-0.09E-6	0.9841	0.00274	0.0005	0.00344	<.0001	-0.0004	0.3656	0.00031	0.5387
BLACK	0.05372	<.0001	0.11729	<.0001	0.10103	<.0001	0.04369	<.0001	0.06826	<.0001
HISPANIC	0.00942	0.5541	0.03203	0.2288	0.02186	0.2028	0.00689	0.6620	0.01739	0.2732
OTHERRACE	0.01352	0.1817	0.04121	0.0085	0.03153	0.0018	0.00944	0.3511	0.02529	0.0105
ROTCSCHOLAR	-0.08407	<.0001	-0.0520	<.0001	-0.0327	<.0001	-0.0921	<.0001	-0.0845	<.0001
ROTCNONSCHOLAR	-0.01576	0.0476	0.08921	<.0001	0.08464	<.0001	-0.0348	<.0001	0.00066	0.9296
OCS	-0.07147	<.0001	0.10742	<.0001	0.09911	<.0001	-0.1035	<.0001	-0.0303	0.0277
DIRAPPOINT	-0.22796	<.0001	-0.1143	<.0001	-0.0524	<.0001	-0.2567	<.0001	-0.2178	<.0001
FEMALE	-0.08115	<.0001	-0.1335	<.0001	-0.1102	<.0001	-0.0747	<.0001	-0.0772	<.0001
MARRIED	0.27371	<.0001	0.34437	<.0001	0.29932	<.0001	0.27131	<.0001	0.24599	<.0001
NOFDEPENDENTS	0.11698	<.0001	0.13396	<.0001	0.10474	<.0001	0.11661	<.0001	0.12903	<.0001
PRIORENLISTED	-0.00174	0.7863	0.04319	<.0001	0.04060	<.0001	-0.0076	0.2328	-0.0021	0.7395
GRADEDUCATION	1.16180	<.0001	1.56641	<.0001	1.19524	<.0001	1.14422	<.0001	1.22327	<.0001
AVIATION	0.23936	<.0001	0.23691	<.0001	0.17871	<.0001	0.24597	<.0001	0.24033	<.0001
AIRDARTILLERY	-0.10085	<.0001	-0.1198	<.0001	-0.0892	<.0001	-0.1034	<.0001	-0.0944	<.0001
INTELLIGENCE	-0.04485	0.0005	-0.0755	0.0001	-0.0424	0.0009	-0.0446	0.0005	-0.0433	0.0005
ENGINEERING	-0.07684	<.0001	-0.1131	<.0001	-0.0850	<.0001	-0.0750	<.0001	-0.0777	<.0001
SPECIAL	-0.02960	0.0022	-0.0229	0.1334	-0.0062	0.5250	-0.0333	0.0006	-0.0258	0.0066
ADMINISTRATIVE	-0.11599	<.0001	-0.1536	<.0001	-0.1159	<.0001	-0.1153	<.0001	-0.1158	<.0001
MILPOLICE	-0.02322	0.1917	-0.0273	0.3365	-0.0199	0.2767	-0.0240	0.1734	-0.0168	0.3350
LOGISTICIAN	-0.09176	<.0001	-0.1195	0.0010	-0.0775	0.0009	-0.0928	<.0001	-0.0948	<.0001
SUPPLY	-0.06852	0.0016	-0.0865	0.0120	-0.0755	0.0007	-0.0668	0.0020	-0.0755	0.0003
TRANSPORTATION	-0.05111	0.0002	-0.0592	0.0074	-0.0415	0.0036	-0.0526	0.0001	-0.0528	<.0001
OTHERMO	-0.04918	<.0001	-0.0799	<.0001	-0.0675	<.0001	-0.0485	<.0001	-0.0349	0.0018

[125] Paul D. Allison, *Survival Analysis*, 65.

FY82	0.01580	0.3408	0.02862	0.2231	0.01444	0.3404	0.01225	0.4654	0.02448	0.1273
FY83	0.02472	0.1259	0.01667	0.4681	-0.0147	0.3190	0.02809	0.0853	0.02965	0.0559
FY84	0.02711	0.0838	0.04757	0.0334	-0.0062	0.6638	0.02800	0.0773	0.02962	0.0490
FY85	0.00168	0.9274	0.01737	0.5140	-0.0541	0.0016	0.00414	0.8241	0.00979	0.5792
FY86	0.01852	0.2562	0.02698	0.2514	-0.0522	0.0006	0.02251	0.1717	0.02368	0.1312
FY87	0.00601	0.7175	0.01900	0.4310	-0.0694	<.0001	0.01204	0.4729	-0.0009	0.9534
FY88	0.03372	0.0359	0.08077	0.0005	-0.0266	0.0768	0.03670	0.0236	0.02743	0.0763
FY89	0.01244	0.4332	0.07867	0.0006	-0.0401	0.0069	0.01309	0.4139	0.00868	0.5708
FY90	0.03860	0.0162	0.12714	<.0001	-0.0040	0.7870	0.03490	0.0310	0.04236	0.0066
FY91	0.11036	<.0001	0.22428	<.0001	0.06332	<.0001	0.10384	<.0001	0.12638	<.0001
FY92	0.17751	<.0001	0.31539	<.0001	0.12100	<.0001	0.17091	<.0001	0.19772	<.0001
FY93	0.15950	<.0001	0.30557	<.0001	0.09186	<.0001	0.15478	<.0001	0.17554	<.0001
FY94	0.14516	<.0001	0.32384	<.0001	0.09060	<.0001	0.13636	<.0001	0.16980	<.0001
FY95	0.17898	<.0001	0.35970	<.0001	0.09776	<.0001	0.17493	<.0001	0.20138	<.0001
FY96	0.25101	<.0001	0.50326	<.0001	0.18485	<.0001	0.24383	<.0001	0.28221	<.0001
FY97	0.37265	<.0001	0.72127	<.0001	0.31345	<.0001	0.36281	<.0001	0.41789	<.0001
FY98	0.40448	<.0001	0.76662	<.0001	0.31154	<.0001	0.39981	<.0001	0.43597	<.0001
FY99	0.44671	<.0001	0.89156	<.0001	0.35797	<.0001	0.44326	<.0001	0.46996	<.0001
FY00	0.55007	<.0001	1.23942	<.0001	0.56981	<.0001	0.54059	<.0001	0.55428	<.0001
FY01	0.64583	<.0001	1.85382	<.0001	0.90568	<.0001	0.60910	<.0001	0.72348	<.0001
SCALE	0.74326		1.00000		0.64487		0.75600		0.42063	

Table 21 summarizes the log-likelihoods for the models. As seen in the table, the model with the logistic distribution has the lowest log-likelihood value, which indicates that it is the model that fits best. However the log-likelihood magnitudes for the normal and gamma distributions are also close to that of the logistic distribution.

Table 21.   Log-likelihoods for the Occupation Models

DISTRIBUTION	LOG-LIKELIHOOD
LOG-NORMAL	-94,919
EXPONENTIAL	-108,296
WEIBULL	-100,622
GAMMA	-94,801
LOG-LOGISTIC	-94,522

Figure 35 shows the plots for all of the five distributions for the occupation model. As seen in the figure, the plots of the normal, gamma and logistic distributions show that they fit better than the exponential and Weibull distributions, which is consistent with the log-likelihood results.
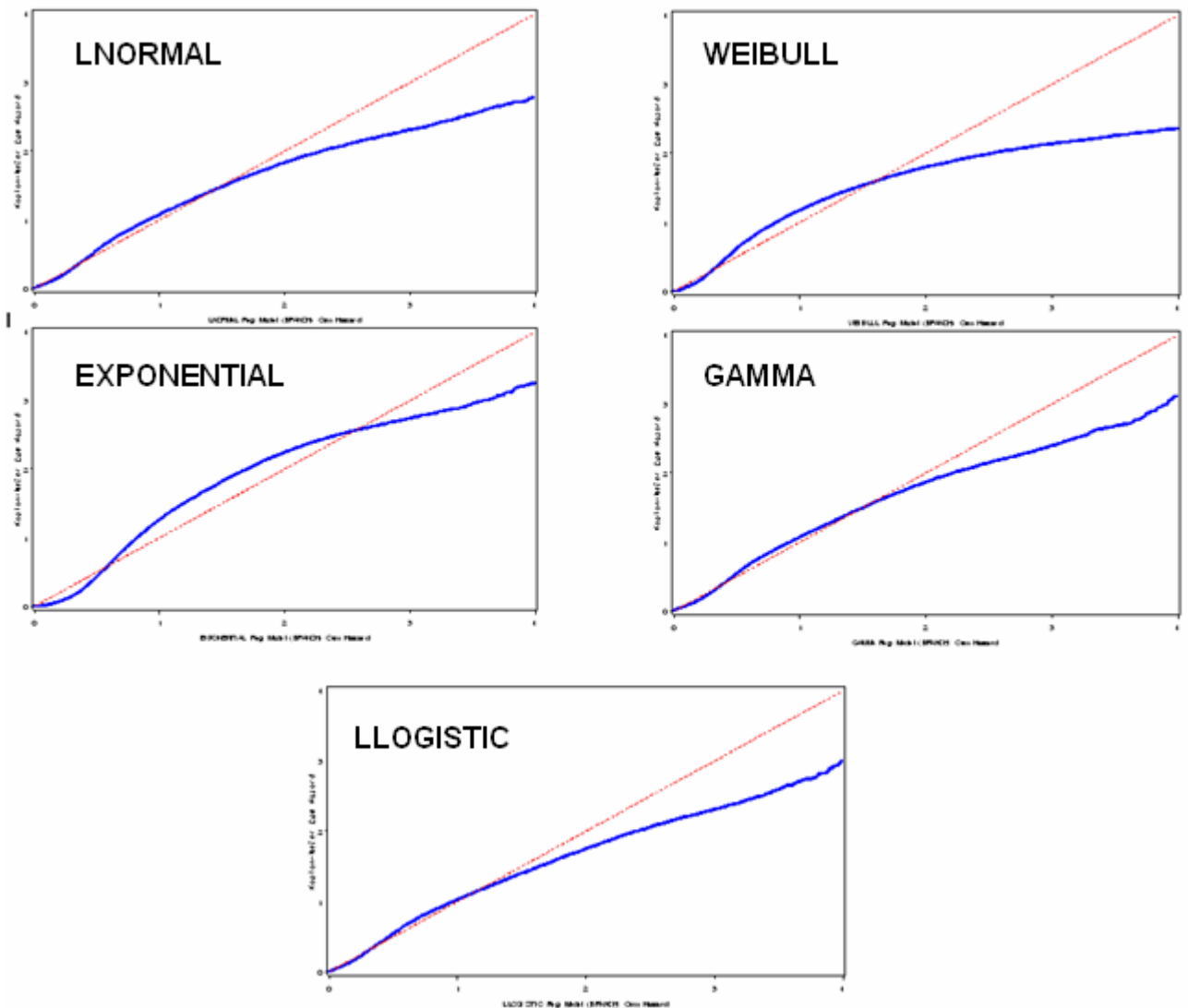
Figure 35.   Residual Plots for Occupation Model

Since the logistic distribution fits the best, the model based on the logistic distribution is used for discussion and interpretation. The results of the model indicate that graduates of all of the other commissioning sources, except for ROTC Non-Scholarship, have shorter service lengths than USMA graduates, holding other factors

constant. The expected service time for Direct Commissioning officers is 19.57% shorter than that of USMA graduates. ROTC Scholarship and OCS graduates have expected service times which are 8.11% and 2.99% shorter, respectively, when compared to the expected service time of USMA graduates. The variable that represents the ROTC Non Scholarship graduates is not statistically significant in the Log-Logistic Model. However, in all of the other models, it is statistically significant. In the Log-normal and gamma models, its sign is negative while in the exponential and Weibull models it has a positive sign. This means that ROTC Non-Scholarship graduates have shorter times of service than USMA graduates according to the results of the log-normal, and Gamma models. Their expected time of service is longer than the expected time of service of the USMA graduates based on the exponential and Weibull models.

Aviators have 27.17% longer expected service time than IACF officers. All of the officers from the occupations other than aviation are found to have shorter expected service times than IACF (Infantry + Armor + Cavalry + Field Artillery) officers. The expected service time for AIRDARTILLERY is 9.01% shorter, for INTELLIGENCE it is 4.24% shorter, for ENGINEERING it is 7.48% shorter, for SPECIAL it is 2.55% shorter, for ADMINISTRATIVE it is 10.94% shorter, for LOGISTICIAN it is 9.05%shorter, for SUPPLY it is 7.28% shorter, for TRANSPORTATION it is 5.15% shorter and for OTHER occupations it is 3.44% shorter than the expected service time for the IACF occupations. The variable for military police is not significant.

The effects of the demographic factors are as follows: Each additional year in age at commissioning results in a 0.0313 percent increase in the service times of commissioning officers, controlling for the other covariates. This effect is not statistically significant in the Log-Logistic Model. However, for the exponential and Weibull models, it is significant. Among the race and ethnicity variables, the variable BLACK is significant at one percent level, showing that black officers have 7.06% longer service times than white officers. The variable OTHERRACE is significant at the five percent level. Officers of other races which are not specified in the study have a 2.56% longer service times than white officers. The variable HISPANIC is not statistically significant in any of the models.

Female officers have a 7.43% shorter service time than males. Married officers have a 27.89% longer service time than single officers. Each additional non-spousal dependent results in a 13.77% increase in the service times of commissioning officers, controlling for the other covariates. Being prior enlisted is not found to have a significant effect on service times. However, for the exponential and Weibull models, it is statistically significant and the sign of the coefficient is positive which indicates prior enlisted are expected to have longer service times when compared to officers who are not prior enlisted. Officers who have graduate degrees have a service time 2.39 times longer than that of the officers who don't have graduate degrees. The officers who were commissioned in 1983, 1984, 1988, and after 1989 are found to have longer service times than the officers who were commissioned in 1981, which is the base year. The effects of the other commissioning years are not statistically significant.

The scale value indicates the differences in the shape of the hazard function. It is 0.42063 for the logistic model. It is smaller than one. This means that the hazard of leaving the service is zero at the very beginning. Then it rises to a peak and later on, it declines toward zero.[126]

The following table represents the results of the occupational category model. The signs of the coefficients and their values are interpreted in the same way as they are in the occupational model.

Table 22.   Results of the PROC LIFEREG Procedure for the Occupation Category Model

VARIABLES	LNORMAL		EXPONENTIAL		WEIBULL		GAMMA		LLOGISTIC	
	EST.	PR > CHI SQ	EST.	PR > CHI SQ	EST.	PR > CHI SQ	EST.	PR > CHI SQ	EST.	PR > CHI SQ
INTERCEPT	1.56725	<.0001	1.57909	<.0001	1.73901	<.0001	1.55097	<.0001	1.51208	<.0001
AGE	2,5E-06	0.9958	0.00274	0.0005	0.00344	<.0001	-0.0004	0.3962	0.00034	0.4954
BLACK	0.04243	<.0001	0.10262	<.0001	0.08930	<.0001	0.03310	0.0002	0.05590	<.0001
HISPANIC	-0.0003	0.9824	0.02042	0.4428	0.01280	0.4563	-0.0027	0.8629	0.00676	0.6710
OTHERRACE	0.00862	0.3957	0.03486	0.0260	0.02645	0.0089	0.00484	0.6338	0.01965	0.0478
ROTCSCHOLAR	-0.0980	<.0001	-0.0663	<.0001	-0.0425	<.0001	-0.1062	<.0001	-0.0991	<.0001
ROTCNONSCHOLAR	-0.0231	0.0037	0.08077	<.0001	0.07876	<.0001	-0.0416	<.0001	-0.0060	0.4224
OCS	-0.0942	<.0001	0.08192	0.0003	0.07944	<.0001	-0.1249	<.0001	-0.0541	<.0001
DIRAPPOINT	-0.2321	<.0001	-0.1072	<.0001	-0.0400	0.0001	-0.2611	<.0001	-0.2247	<.0001
FEMALE	-0.0883	<.0001	-0.1451	<.0001	-0.1193	<.0001	-0.0820	<.0001	-0.0839	<.0001

[126] Paul D. Allison, *Survival Analysis*, 70.

MARRIED	0.27896	<.0001	0.34978	<.0001	0.30345	<.0001	0.27669	<.0001	0.25319	<.0001
NOFDEPENDENTS	0.11773	<.0001	0.13409	<.0001	0.10469	<.0001	0.11751	<.0001	0.12960	<.0001
PRIORENLISTED	-0.0016	0.7931	0.04359	<.0001	0.04103	<.0001	-0.0074	0.2502	-0.0017	0.7901
GRADEDUCATION	1.16159	<.0001	1.56441	<.0001	1.19427	<.0001	1.14487	<.0001	1.2221	<.0001
COMBATSUPPORT	-0.0375	0.0003	-0.0505	0.0020	-0.0286	0.0068	-0.0380	0.0003	-0.0373	0.0002
COMBATSERVICESUPPORT	-0.0727	<.0001	-0.0881	<.0001	-0.0667	<.0001	-0.0731	<.0001	-0.0762	<.0001
SPECIALBRANCHES	-0.0385	<.0001	-0.0359	0.0030	-0.0246	0.0016	-0.0411	<.0001	-0.0339	<.0001
FY82	0.01780	0.2847	0.03289	0.1613	0.01890	0.2126	0.01417	0.3998	0.02650	0.0997
FY83	0.02735	0.0915	0.02134	0.3530	-0.0109	0.4593	0.03018	0.0653	0.03287	0.0346
FY84	0.03327	0.0341	0.05868	0.0085	0.00390	0.7863	0.03346	0.0350	0.03569	0.0179
FY85	0.02385	0.1920	0.05308	0.0431	-0.0222	0.1905	0.02485	0.1782	0.02998	0.0857
FY86	0.02266	0.1574	0.04228	0.0667	-0.0360	0.0153	0.02498	0.1226	0.02496	0.1049
FY87	0.01208	0.4550	0.04090	0.0804	-0.0465	0.0021	0.01604	0.3253	0.00032	0.9833
FY88	0.03839	0.0140	0.09949	<.0001	-0.0062	0.6683	0.03947	0.0122	0.02743	0.0680
FY89	0.01172	0.4485	0.09037	<.0001	-0.0255	0.0770	0.01046	0.5025	0.00422	0.7768
FY90	0.04115	0.0086	0.14238	<.0001	0.01258	0.3932	0.03582	0.0233	0.04183	0.0060
FY91	0.11705	<.0001	0.24617	<.0001	0.08521	<.0001	0.10853	<.0001	0.13084	<.0001
FY92	0.18525	<.0001	0.33699	<.0001	0.14277	<.0001	0.17694	<.0001	0.20332	<.0001
FY93	0.15987	<.0001	0.32077	<.0001	0.11107	<.0001	0.15280	<.0001	0.17280	<.0001
FY94	0.15178	<.0001	0.34804	<.0001	0.11628	<.0001	0.14087	<.0001	0.17212	<.0001
FY95	0.18772	<.0001	0.38648	<.0001	0.12515	<.0001	0.18120	<.0001	0.20756	<.0001
FY96	0.25901	<.0001	0.52856	<.0001	0.21070	<.0001	0.24954	<.0001	0.28887	<.0001
FY97	0.37983	<.0001	0.74544	<.0001	0.33859	<.0001	0.36784	<.0001	0.42232	<.0001
FY98	0.40807	<.0001	0.78666	<.0001	0.33434	<.0001	0.40109	<.0001	0.43655	<.0001
FY99	0.45061	<.0001	0.90995	<.0001	0.37919	<.0001	0.44512	<.0001	0.47027	<.0001
FY00	0.55489	<.0001	125.685	<.0001	0.59082	<.0001	0.54362	<.0001	0.55729	<.0001
FY01	0.64924	<.0001	186.784	<.0001	0.92471	<.0001	0.61175	<.0001	0.72558	<.0001
SCALE	0.74604		100.000		0.64601		0.75852		0.42275	

Table 23 summarizes the log-likelihood values for the models. As seen in the table, the model with the logistic distribution has the lowest value which indicates that it is the model which fits the data the best. Therefore, log-logistic model is the best fit for both the occupation and the occupation category models. As in the occupation model, the log-likelihood magnitudes for the normal and gamma distributions are also close to that of the logistic distribution.

Table 23.   Log-likelihoods for the Occupation Category Models

DISTRIBUTION	LOG-LIKELIHOOD
LOG-NORMAL	-95,238
EXPONENTIAL	-108,458
WEIBULL	-100,849
GAMMA	-95,130
LOG-LOGISTIC	-94,881

The following figure shows the plots for all of the five distributions for the occupation category model. As in the occupation model, the plots of the normal, gamma and logistic distributions show that they fit better than the exponential and Weibull distributions for the occupation category model, which is consistent with the log-likelihood results.
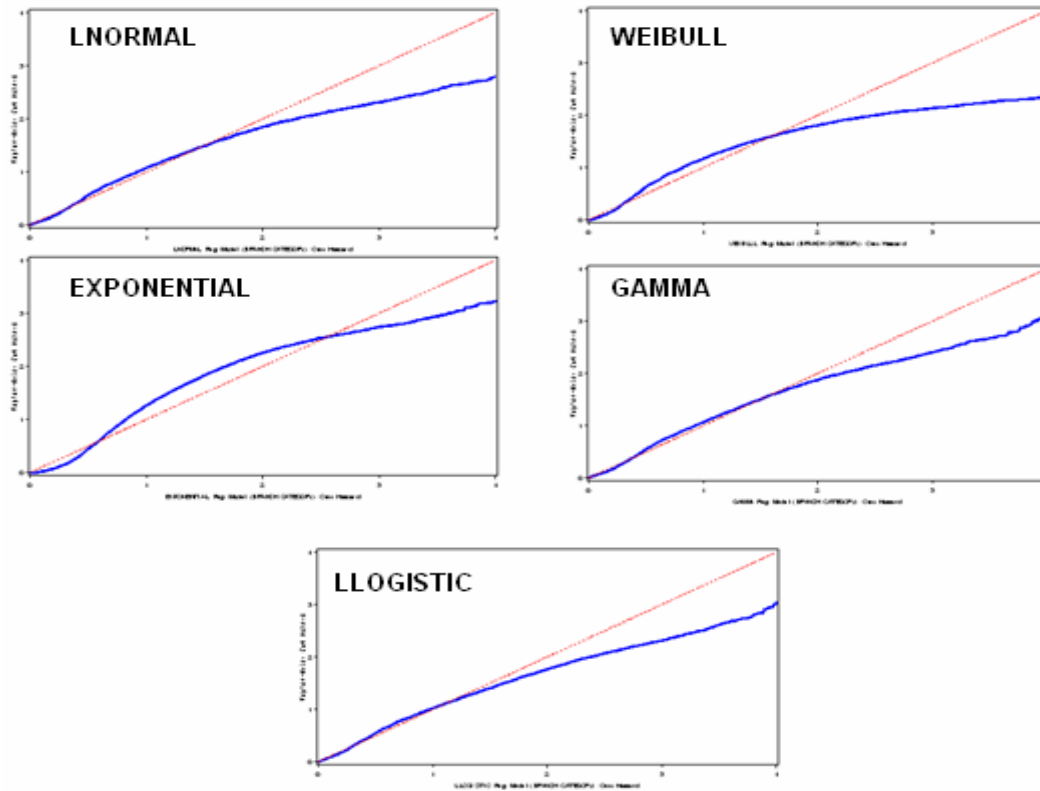
Figure 36.   Residual Plots for Occupation Category Model

Since the logistic distribution fits the best, the model with the logistic distribution will be used for interpretation. The results of the occupation category model are consistent with the results of the occupation model except for the ROTCNONSCHOLARSHIP variable. The occupation category model indicates that graduates of all of the other commissioning sources have shorter times of service than that of USMA graduates, holding other things constant. The expected service time for Direct Commissioning officers is 20.63% shorter than that of USMA graduates. ROTC Scholarship and OCS graduates have expected service times which are 9.44% and 5.27% shorter when compared to the expected service time of USMA graduates. The expected service time for ROTC Non Scholarship graduates is 0.61% shorter than that of USMA graduates.

All of the occupation category variables are statistically significant in the occupation category model. The base occupation category is the COMBAT ARMS. All of the other occupation categories are found to have shorter expected service times than COMBAT ARMS officers. The expected service time for COMBATSERVICESUPPORT is 7.34% shorter, COMBATSUPPORT is 3.67% shorter, and SPECIALBRANCH occupation category is 3.34% shorter than the expected service time for the COMBATARMS occupation category.

The demographic factors have parallel results with the occupation model. Controlling for the other covariates, each additional year in age at commissioning results in a 0.03 percent increase in the service times of commissioning officers. This effect is not statistically significant in the Log-Logistic Model. However, for the exponential and Weibull models, it is significant. Among the race and ethnicity variables, the variable BLACK is significant at one percent level, showing that black officers have 5.75% longer service times than white officers. Officers from OTHERRACE have 1.98% longer service time than white officers. The variable HISPANIC is not statistically significant in any of the models.

Female officers have an 8.05% shorter service time than males. Married officers have a 28.81% longer service time than single officers. Each additional non-spousal dependent results in a 13.84% increase in the service times of commissioning officers,

controlling for the other covariates. Being prior enlisted is not found to have a significant effect on service times. However, as in the occupation model, for the exponential and Weibull models, it is statistically significant. Officers who have graduate degrees have a service time 2.39 times longer than that of the officers who don't have graduate degrees. The officers who were commissioned in 1982, 1983, 1984, 1985, 1988, and after 1989 are found to have longer service times than the officers who were commissioned in 1981, which is the base year. The effects of the other commissioning years are not statistically significant.

The scale value is 0.42275 for the logistic model. It is smaller than the scale value in the occupation model and indicates that the hazard function is slightly more compressed.[127]

C. ESTIMATING COX REGRESSION MODELS WITH PROC PHREG

The two models that were estimated using the LIFEREG procedure in SAS were also estimated using the PHREG procedure. Table 24 and table 25 include three alternative statistics (likelihood ratio, score and Wald tests) for testing the global null hypothesis for the occupation and occupation category models. The global null hypothesis is that all of the coefficients are equal to zero.

Likelihood-ratio statistics are calculated by maximizing the likelihood under the null hypothesis and with the null hypothesis relaxed. The statistic is twice the positive difference in the two log-likelihoods. Wald statistics are calculated by using certain functions of parameter estimates and their estimated variances and covariances. Score statistics are calculated by using similar functions of the first and second derivatives of the likelihood function. All of the three methods can be used to test if all of the coefficients are equal to zero.[128]

The following tables represent the results of the tests. The probabilities associated with all of the test statistics show that the null hypothesis can be rejected and that the coefficients are not equal to zero.

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[127] Paul D. Allison, *Survival Analysis*, 70.

[128] Ibid, 85-86.

Table 24.   Test Statistics for the Occupation Model

TEST	CHI-SQUARE	DF	PR>CHISQ
LIKELIHOOD RATIO	34154.3613	44	< .0001
SCORE	31632.1148	44	< .0001
WALD	27963.4693	44	< .0001

Table 25.   Test Statistics for the Occupation Category Model

TEST	CHI-SQUARE	DF	PR>CHISQ
LIKELIHOOD RATIO	33682.4224	36	< .0001
SCORE	31177.0368	36	< .0001
WALD	27546.6774	36	< .0001

Table 26 summarizes the results of these two models. Hazard ratios showing the effects of the explanatory variables on the risk of leaving the service are reported in the table. For binary variables, a hazard ratio higher than one indicates a hazard greater than the base case while a hazard ratio smaller than one indicates a hazard smaller than the base case. For example, the hazard ratio for the variable ROTCNONSCHOLAR is 0.937 in the occupation model. This means that, controlling for the other variables, the hazard of separation for an ROTC Non-Scholarship graduate is 93.7% of that of a USMA graduate, which is the base case. The hazard ratio for the variable FEMALE is 1.161. This means that, controlling for the other variables, the hazard of separation for a female commissioned Army officer is 116.1% of that of a male commissioned Army officer, which is the base case. For continuous variables such as AGE the interpretation is different. For example, the hazard ratio for the variable AGE is 0.996. This hazard ratio indicates that each additional year in age at commissioning results in a 0.4% ((1-0.996) ×100=0.4) decrease in the hazard of separation for commissioned officers in the Army. If there were two officers who have the ages of 25 and 35 at commissioning, the difference in the hazard of separation between them would be 4% ((35-25) × 0.4% = 4%). Since the hazard ratio is smaller than one, the hazard of separation for the 35 year old officer would be 4% smaller than that of the 25 year old officer.

The coefficients of all of the variables that are common to the occupation and occupational category models have the same signs which show that the directions of the

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effects of the variables are consistent in both of the models. The variables that are statistically significant are also the same in both of the models except for the variable FY85.

The occupation model indicates that ROTC Scholarship and Direct Appointment graduates have higher hazard ratios, while ROTC Non-Scholarship and OCS graduates have lower hazard ratios than USMA graduates, controlling for the other variables. The hazard for ROTC Scholarship graduates is 109.6% of that of USMA graduates and the hazard for Direct Commissioning officers is 118.6% of that of USMA graduates. On the other hand, ROTC Non-Scholarship and OCS graduates have hazards of 93.7% and 92.3% of that of USMA graduates, respectively. The results of the occupational category model are parallel to those of the occupation model. According to the occupational category model, the hazards for ROTC Scholarship graduates and Direct Commissioning officers are 111.2% and 117.2% of the hazard of the USMA graduates. ROTC Non-Scholarship and OCS graduates have hazards of 94.5% and 95.2% of that of USMA graduates. Among all of the commissioning sources, Direct Commissioning has the highest hazard ratio. This may be because of the greater job opportunities Direct Commissioning officers have outside the military.

All of the officers from occupations other than aviation are found to have higher hazards than IACF (Infantry + Armor + Cavalry + Field Artillery) officers, the base case in the occupation model. The aviation officers have a hazard that is 74% of that of IACF officers. The hazard for AIRDARTILLERY is 114.6%, for INTELLIGENCE is 106.1%, for ENGINEERING is 112.8%, for ADMINISTRATIVE is 118%, for LOGISTICIAN is 113.1%, for SUPPLY is 111.9%, for TRANSPORTATION is 106.5% and for OTHER occupations is 108.3% of the hazard of IACF occupations. The Special Occupations and Military Police variables are not found to be significant. Aviators have the lowest hazard ratios, probably because of the length of their obligatory service. IACF officers do not have as many outside job opportunities as the other occupations and this may explain why the hazard ratios of the other occupations are greater than 100%.

In the occupation category model, all of the occupation categories are found to have higher hazards than the combat arms occupation category, which is the base case.

The hazard for COMBATSERVICESUPPORT is 110.7%, for COMBATSUPPORT is 104.5%, and for SPECIALBRANCH occupation category is 103.4% of the hazard of the COMBATARMS occupation category. The high hazard ratios of greater than 100% for the occupational categories is likely the result of the limited number of outside job opportunities associated with officers from combat arms, the base case.

The occupation model and the occupational category model contain the same remaining demographic and military background variables. Since the results for these variables in the two models are similar, the occupation model is discussed in detail first, followed by a more brief discussion of the occupational category model.

For the occupation model, each additional year in age at commissioning results in a 0.4% ((1-0.996) ×100=0.4) decrease in the hazard ratio of commissioned officers in the Army. This result is consistent with the literature. Studies indicate that higher age at commissioning has a positive effect on the survival of officers since greater maturity leads to a higher level of professional success. Another issue about higher commissioning age is that officers who enter the military at higher ages are more likely to be prior enlisted. They often retire at the 20th year of their career, which may lead to lower service time. However, findings in this study indicate that higher age has a small positive effect on the survival curves of officers.

A black officer in the occupation model is found to have 96.6% while officers from other races have 95.6% of the hazard of a white officer. The variable HISPANIC is not found to be significant. These results for race and ethnicity are consistent with the literature. Most of the studies indicate that officers from minority groups are more likely to stay in the military than white officers since minority groups have positive perceptions about pay and training opportunities in the military compared to the civilian sector.

A female officer in the occupation model has a hazard of 116.1% of that of a male officer. This is also parallel to the findings in the literature. Females are expected to have shorter service time than males because of family responsibilities, especially the care of children.

Being married is found to have a positive effect on service time. A married officer has a hazard of 65.5% of that of a single officer. This result is consistent with the literature, which points out that marriage increases the productivity of people at work. Increased productivity is likely to be associated with longer service time for officers.

One additional non-spousal dependent in the occupation model decreases the hazard by 14.3% ((1-0.857) ×100=14.3). This is also consistent with previous studies that have found that the number of non-spousal dependents has a positive effect on the length of service. This is thought to be because each additional non-spousal dependent brings more responsibility with him or her.

In the occupation model, the hazard for a prior enlisted officer is 95.3% of the hazard of an officer who is not prior enlisted. This means that prior enlisted commissioned officers tend to stay longer in the service, which is consistent with the literature. Prior enlisted officers are expected to stay longer because they acquire enlisted experience and military skills which may affect both their performance and retention decisions positively. Another issue related to prior enlisted officers is that they reach retirement eligibility before their nonprior service peers. This may result in fewer prior enlisted officers in the following years. However, findings of this study indicate that being prior enlisted has a positive effect on the length of the service time of Army commissioned officers.

Officers who have graduate degrees have a hazard of 19.1% of that of the officers who don't have graduate degrees in the occupation model. This is also consistent with the literature. One previous study indicates that officers with graduate degrees have a promotion ratio which is 1.79-2.25 times the promotion ratio of officers without graduate degrees.[129] The reason for longer service time for the officers who have graduate education may be associated with the graduate education policy of the Army. The target population in the Army for graduate education is captains who are between their sixth and eighth years of commissioned service.[130] Therefore, the officers who are selected for

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[129] Kabalar Hakan, *Multivariate Analysis of the Effect of Graduate Education on Promotion to Army Lieutenant Colonel*, (Monterey, California: Naval Postgraduate School, June 2003).

[130] Danny W., Braudrick, *U.S. Army Officer Graduate Education: New Methodology for Establishing Requirements and Utilizing Assets*, (Monterey, California: Naval Postgraduate School, December 1986).

graduate education already have six to eight years of service at the time of selection. Since graduate education usually lasts between 18 and 24 months and officers who gain graduate degrees through the Army are obliged to serve for three more years after the completion of graduate education, their service time is likely to be longer than that of the officers who don't have graduate degrees.

The officers who were commissioned in 1982, 1984 and after 1989 in the occupation model are found to have smaller hazards than the officers who were commissioned in 1981, which is the base year. Only the officers who were commissioned in 1987 have higher hazards than the officers who were commissioned in 1981. The effects of the other commissioning years are not statistically significant.

In the occupational category model, each additional year in age at commissioning results in a 0.4% ((1-0.996) ×100=0.4) decrease in the hazard of commissioned officers in the Army. A Black officer is found to have 88.3% of the hazard of a white officer while an officer of another race has 96.4% of the hazard of a white officer. The variable HISPANIC is not found to be significant. Female officers have a hazard that is 117.5% of that of male officers. The hazard for married officers is 65.1% of that of single officers. One additional non-spousal dependent decreases the hazard by 14.3% ((1-0.857) ×100=14.3). The hazard for a prior enlisted officer is 95.2% of the hazard of an officer who is not prior enlisted. Officers who have graduate degrees have a hazard that is 19.2% of that of the officers who don't have graduate degrees. The officers who were commissioned in 1982, 1984, 1985, and after 1989 are found to have smaller hazards than the officers who were commissioned in 1981, which is the base year. The officers who were commissioned in 1987 have a higher hazard than the officers who were commissioned in 1981. The effects of the other commissioning years are not statistically significant.

Table 26. Results of the PHREG Procedure for the Occupation and Occupation
Category Models

	OCCUPATION MODEL			OCCUPATION CATEGORY MODEL		
VARIABLES	ESTIMATE	PR > CHISQ	HAZ.RAT.	ESTIMATE	PR > CHISQ	HAZ.RAT.
AGE	-0.00425	<.0001	0.996	-0.00425	<.0001	0.996
BLACK	-0.14350	<.0001	0.866	-0.12464	<.0001	0.883
HISPANIC	-0.03822	0.1511	0.963	-0.02374	0.3721	0.977
OTHERRACE	-0.04540	0.0037	0.956	-0.03707	0.0178	0.964
ROTCSCHOLAR	0.09138	<.0001	1.096	0.10636	<.0001	1.112
ROTCNONSCHOLAR	-0.06528	<.0001	0.937	-0.05638	<.0001	0.945
OCS	-0.08051	0.0004	0.923	-0.04911	0.0303	0.952
DIRAPPOINT	0.17071	<.0001	1.186	0.15882	<.0001	1.172
FEMALE	0.14931	<.0001	1.161	0.16122	<.0001	1.175
MARRIED	-0.42340	<.0001	0.655	-0.42880	<.0001	0.651
NOFDEPENDENTS	-0.15488	<.0001	0.857	-0.15464	<.0001	0.857
PRIORENLISTED	-0.04829	<.0001	0.953	-0.04871	<.0001	0.952
GRADEDUCATION	-1.65527	<.0001	0.191	-1.65107	<.0001	0.192
AVIATION	-0.30067	<.0001	0.740	-	-	-
AIRDARTILLERY	0.13651	<.0001	1.146	-	-	-
INTELLIGENCE	0.05945	0.0028	1.061	-	-	-
ENGINEERING	0.12034	<.0001	1.128	-	-	-
SPECIAL	0.00767	0.6158	1.008	-	-	-
ADMINISTRATIVE	0.16571	<.0001	1.180	-	-	-
MILPOLICE	0.02536	0.3723	1.026	-	-	-
LOGISTICIAN	0.12278	0.0007	1.131	-	-	-
SUPPLY	0.11205	0.0012	1.119	-	-	-
TRANSPORTATION	0.06333	0.0042	1.065	-	-	-
OTHERMO	0.07996	<.0001	1.083	-	-	-
COMBATSUPPORT	-	-	-	0.04449	0.0066	1.045
COMBATSERVICESUPPORT	-	-	-	0.10199	<.0001	1.107
SPECIALBRANCHES	-	-	-	0.03383	0.0052	1.034
FY82	-0.04901	0.0370	0.952	-0.05470	0.0198	0.947
FY83	-0.03025	0.1891	0.970	-0.03629	0.1150	0.964
FY84	-0.04794	0.0325	0.953	-0.06247	0.0052	0.939
FY85	-0.00387	0.8847	0.996	-0.04812	0.0675	0.953
FY86	0.03390	0.1522	1.034	0.01514	0.5139	1.015
FY87	0.06623	0.0064	1.068	0.03969	0.0917	1.040
FY88	-0.00797	0.7346	0.992	-0.03117	0.1714	0.969
FY89	-0.00074	0.9743	0.999	-0.01657	0.4624	0.984
FY90	-0.08749	0.0002	0.916	-0.10629	<.0001	0.899
FY91	-0.22448	<.0001	0.799	-0.25067	<.0001	0.778
FY92	-0.35821	<.0001	0.699	-0.38381	<.0001	0.681
FY93	-0.35189	<.0001	0.703	-0.37296	<.0001	0.689
FY94	-0.36338	<.0001	0.695	-0.39341	<.0001	0.675
FY95	-0.39198	<.0001	0.676	-0.42452	<.0001	0.654
FY96	-0.55972	<.0001	0.571	-0.58991	<.0001	0.554
FY97	-0.79905	<.0001	0.450	-0.82745	<.0001	0.437

FY98	-0.85810	<.0001	0.424	-0.88348	<.0001	0.413
FY99	-0.99969	<.0001	0.368	-102.287	<.0001	0.360
FY00	-1.36588	<.0001	0.255	-1.38921	<.0001	0.249
FY01	-1.89886	<.0001	0.150	-1.91820	<.0001	0.147

To see if the effect of commissioning source is influenced by the occupation, interaction terms were added to the occupation category model by multiplying each commissioning source by each occupation category (except for the base cases). Table 27 shows the effects of these interaction terms. Many of these interaction terms are found to be significant. The results indicate that for all of the commissioning sources, being assigned to a combat service support occupation significantly decreases the hazard of separation. Being assigned to the special occupation category significantly increases the hazard of separation for ROTC Scholarship, ROTC Non-Scholarship and OCS graduates. Being assigned to combat support does not have a significant effect on any of the sources of commission. The many interaction terms complicated the interpretation of the results and so they were not included in the final models.

Table 27.   Effects of Interaction Terms

INTERACTION TERM	PR > CHISQ	HAZARD RATIO
ROTCSCHOLAR_COMBATSUPPORT	0.2339	0.945
ROTCSCHOLAR_COMBATSERVICESUPPORT	0.0134	0.903
ROTCSCHOLAR_SPECIALBRANCHES	<.0001	1.281
ROTCNONSCHOLAR_COMBATSUPPORT	0.6300	1.022
ROTCNONSCHOLAR_COMBATSERVICESUP	<.0001	0.832
ROTCNONSCHOLAR_SPECIAL	<.0001	1.200
OCS_COMBATSUPPORT	0.3208	1.072
OCS_COMBATSERVICESUPPORT	<.0001	0.612
OCS_SPECIALBRANCHES	<.0001	1.661
DIRAPPOINT_COMBATSUPPORT	0.7728	0.970
DIRAPPOINT_COMBATSERVICESUPPORT	0.0001	0.733
DIRAPPOINT_SPECIALBRANCHES	0.9002	1.006
This table is for the PHREG Occupation Category Model results. The results are selected variables from the larger model.		

Being an OCS graduate and being a prior enlisted officer are highly correlated. In the data set, 75% of the OCS graduates are prior enlisted. However, both the prior enlisted and OCS variables are statistically significant and they have the expected signs, or, in the case of OCS, an unexpected sign that might be explained by the survival patterns of the OCS and USMA graduates Therefore, the collinearity between these variables does not seem to be a serious problem in the study.

VIII. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

A.   SUMMARY

In this study, three SAS procedures are used to analyze the survival of Army officers. PROC LIFETEST is used for preliminary survival data analysis while PROC LIFEREG and PROC PHREG are used to estimate multivariate survival and hazard models. Two different models are specified for each procedure. The models differ in the level of aggregation of military occupation.

The results of PROC LIFETEST indicate that the estimated survival function of officers is not very steep until the end of obligated service which is four years for most officers (except aviators). After the fourth year the survival curve falls steeply until the promotion point to major (12-13 years of service). The survival curve declines again at 20 years of service, which is the time of retirement eligibility.

A comparison of the survival curves of different groups based on commissioning source and occupation indicates that the survival functions of these groups of Army officers differ. USMA graduates have the highest survival curve until the fifth year of service because of their longer active duty service obligation. After the sixth year of service, OCS graduates have the highest survival curve. The second highest survival curve belongs to ROTC Non-Scholarship graduates. The survival curves of USMA and ROTC Scholarship graduates are close to each other after the eighth year of service and they are below the survival curve of ROTC Non-Scholarship graduates. Except for the period between years five and 10, Direct Commissioning officers always have the lowest survival curve.

Among the disaggregated occupations, aviators have the highest survival until 21 years of service because of the greater length of their initial obligation. Among the other occupations, the intelligence occupation has the highest survival curve until the fifth year. Between the fifth and 17th years, the military police occupation has the highest survival curve and between the 17th and the 20th years, the IACF (Infantry + Armor + Cavalry +

Field Artillery) occupations have the highest survival curve. After the 21st year, the air defense artillery occupation has the highest survival curve among all of the occupations including aviation.

Among the aggregated occupation categories, combat arms has the highest survival curve throughout, which is likely due to the lack of civilian job opportunities for officers in this category. Until the 11th year of service, combat service support has the second highest survival curve, but after the 11th year the special branch has the second highest survival curve. The combat support occupation group has the lowest survival curve throughout.

PROC LIFEREG allows using five different distributions to estimate survival models. Among these distributions, the logistic distribution fits the data best for both the occupation and the occupation category models and is used for interpretations. Table 28 summarizes the findings of LIFEREG and PHREG regressions for both the occupation and occupation category models. Among the five distributions for the LIFEREG procedure, only the results of log-logistic are reported since it fits best.

Table 28.   Results of the LIFEREG LOG-LOGISTIC and PHREG Regressions for the Occupation and Occupation Category Models

VARIABLES	OCCUPATION MODEL		OCCUPATION CATEGORY MODEL	
	LIFEREG LOG-LOGISTIC	PHREG	LIFEREG LOG-LOGISTIC	PHREG
AGE	0.03	0.996 ***	0.03	0.996 ***
BLACK	7.06 ***	0.866 ***	5.75 ***	0.883 ***
HISPANIC	1.75	0.963	0.68	0.977
OTHERRACE	2.56 **	0.956 ***	1.98 **	0.964 **
ROTCSCHOLAR	-8.11 ***	1.096 ***	-9.44 ***	1.112 ***
ROTCNONSCHOLAR	0.07	0.937 ***	-0.61	0.945 ***
OCS	-2.99 ***	0.923 ***	-5.27 ***	0.952 **
DIRAPPOINT	-19.57 ***	1.186 ***	-20.13 ***	1.172 ***
FEMALE	-7.43 ***	1.161 ***	-8.05 ***	1.175 ***
MARRIED	27.89 ***	0.655 ***	28.81 ***	0.651 ***
NOFDEPENDENTS	13.77 ***	0.857 ***	13.84 ***	0.857 ***
PRIORENLISTED	-0.21	0.953 ***	-0.17	0.952 ***
GRADEDUCATION	239.83 ***	0.191 ***	239.43 ***	0.192 ***
AVIATION	27.17 ***	0.740 ***	-	-
AIRDARTILLERY	-9.01 ***	1.146 ***	-	-
INTELLIGENCE	-4.24 ***	1.061 ***	-	-

ENGINEERING	-7.48 ***	1.128 ***	-	-
SPECIAL	-2.55 ***	1.008	-	-
ADMINISTRATIVE	-10.94 ***	1.180 ***	-	-
MILPOLICE	-1.67	1.026	-	-
LOGISTICIAN	-9.05 ***	1.131 ***	-	-
SUPPLY	-7.28 ***	1.119 ***	-	-
TRANSPORTATION	-5.15 ***	1.065 ***	-	-
OTHERMO	-3.44 ***	1.083 ***	-	-
COMBATSUPPORT	-	-	-3.67 ***	1.045 ***
COMBATSERVICESUPPORT	-	-	-7.34 ***	1.107 ***
SPECIALBRANCHES	-	-	-3.34 ***	1.034 ***
* Significant at 0.10 level				
** Significant at 0.05 level				
*** Significant at 0.01 level				
LIFEREG results show the percent change in the expected service time of officers. They are calculated by taking e^{β} of the coefficients. PHREG result show the hazard ratios compared to base cases.				
All of the year variables except for FY87 indicate that the officers commissioned through FY82-FY01 have longer expected service times when compared to the officers commissioned in FY81 which is the base year. FY86 and FY89 are not significant in any of the models.				

In both the occupation and occupation category models, all of the other commissioning sources have significantly shorter service times than USMA graduates, except for the ROTC Non-Scholarship graduates. The ROTC Non Scholarship variable is not statistically significant in either model. Expected service time for Direct Commissioning officers is shorter than that of USMA graduates by about 20%, while ROTC scholarship officers have about 9% shorter service in both models. OCS officers' service time is shorter by 3% in the occupation model and 5% in the occupation category model.

Among the disaggregated occupations, aviators have 27.17% longer expected service time than IACF (Infantry + Armor + Cavalry + Field Artillery) officers. All of the officers from the other occupations, except military police, have shorter expected service times than IACF officers. The variable for military police is not significant.

Among the occupation categories, combat arms officers have longest expected service time. The expected service time for combat service support is 7.34% shorter, combat support is 3.67% shorter, and special branch occupation category is 3.34% shorter than that of combat arms.

The demographic factors have parallel results in the occupation and occupation category models. Commissioning age has a positive effect on the service time. However, this effect is only significant when using the exponential and Weibull distributions (not for the logistic distribution) for both models. Black officers and officers of races other than the ones specified in the model have longer service times than white officers. The variable HISPANIC is not statistically significant in any of the models.

Being female has a negative effect on expected service time while each additional non-spousal dependent has a positive effect. Being prior enlisted has a positive effect on service time only when using the exponential and Weibull distributions for both models. For the other distributions, it is not statistically significant. Officers with graduate degrees have significantly longer expected service than the officers who do not.

Occupation and occupation category Cox proportional hazard models are also estimated using the PROC PHREG procedure, which does not require choosing a probability distribution. It reports hazard ratios that are used to compare the hazard of leaving the Army between officers. Table 28 summarizes the results of these models.

Results for the commissioning source variables indicate that ROTC Scholarship and Direct Appointment graduates have higher hazard ratios, while ROTC Non-Scholarship and OCS graduates have smaller hazard ratios than USMA graduates, controlling for the other variables. All of the commissioning source variables are statistically significant.

The hazard of leaving the service for ROTC Scholarship graduates is 109.6% and for Direct Commissioning officers is 118.6% that of USMA graduates. On the other hand, the hazard for ROTC Non-Scholarship graduates is 93.7% and OCS graduates is 92.3% of that of USMA graduates for the disaggregated occupation model. Results of the occupational category model are similar, showing the hazards of leaving the service for ROTC Scholarship graduates and Direct Commissioning officers are 111.2% and 117.2% of the hazard of the USMA graduates, while ROTC Non-Scholarship and OCS graduates have hazards of 94.5% and 95.2% of that of USMA graduates.

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In the disaggregated occupation model, all of the occupations but aviation have higher hazards of leaving the service than IACF (Infantry + Armor + Cavalry + Field Artillery) officers, the base case. Aviators have a significantly lower hazard of leaving while special occupation and military police are not statistically significant.

In the aggregated occupation category model, combat support, combat service support and special occupation categories have higher hazards of leaving than combat arms. All of the occupation categories are statistically significant.

For the demographic factors, the occupation and occupation category models have parallel results. Commissioning age has a negative effect on the hazard of leaving the service. Black officers have lower hazards than white officers, the base case. The variable OTHERRACE has a negative effect on the hazard of leaving. The variable HISPANIC is not statistically significant in any of the models.

Female officers have higher hazards of leaving the service while each additional non-spousal dependent is found to have a negative effect on the hazard ratio. Prior enlisted officers have lower hazard ratios than the officers who are not prior enlisted. Officers with graduate degrees have lower hazard ratios than those who do not.

Table 29 summarizes the hypothesized and observed effects for occupation and occupation category models. All of the demographic variables have the expected signs. Among the commissioning sources, ROTC Scholarship and Direct Appointment have the expected signs. However, ROTC Non-Scholarship and OCS have different signs than expected. ROTC Non-Scholarship graduates do not have significantly different time in service from USMA graduates in the LIFEREG results for either of the models, but the PHREG results indicate that they have significantly longer service times when compared to USMA graduates. OCS graduates have significantly shorter service times than USMA graduates in the LIFEREG regressions while they have significantly lower hazard of leaving in the PHREG regressions. The LIFETEST results, which were discussed earlier, indicate that the survival curves of USMA and OCS graduates cross at the sixth year. Until the sixth year, the survival curve of USMA graduates is higher than that of OCS graduates. However, after the sixth year, OCS graduates have the highest survival curve

among all of the commissioning sources. This pattern may be the source of the contradiction in the sign of the OCS variable in the LIFEREG and PHREG results

All of the significant occupation variables have the expected signs. The special occupation variable is found to be statistically significant in the LIFEREG regressions while it is not in the PHREG regressions. The military police occupation is significant in neither the LIFEREG nor the PHREG regressions. When all of these occupations are aggregated in order to form occupation categories, all of the occupation category variables are statistically significant and they all have shorter service times than the combat arms occupation category, which is expected.

Being prior enlisted has the expected effect in the PHREG regressions (positive). However, in the LIFEREG regressions, it has a negative sign which is not significant. Some studies have found that prior enlisted people reach retirement eligibility before their peers, resulting in fewer prior service officers remaining in subsequent years. This effect might explain the negative sign. However, the significant effects have positive signs which are expected because of the acquired enlisted experience and military skills which are likely to affect performance and retention decisions positively. Graduate education has the expected sign for all of the models and regressions.

Table 29.   Hypothesized and Observed Effects of the Variables

VARIABLES	HYPOTHESIZED EFFECT	OCCUPATION MODEL		OCCUPATION CATEGORY MODEL	
		LIFEREG LLOGISTIC	PHREG	LIFEREG LLOGISTIC	PHREG
DEMOGRAPHICS					
AGE	+	+	+ ***	+	+ ***
WHITE	BASE	BASE	BASE	BASE	BASE
BLACK	+	+ ***	+ ***	+ ***	+ ***
HISPANIC	+	+	+	+	+
OTHERRACE	+	+ **	+ ***	+ **	+ **
MALE	BASE	BASE	BASE	BASE	BASE
FEMALE	-	- ***	- ***	- ***	- ***
SINGLE	BASE	BASE	BASE	BASE	BASE
MARRIED	+	+ ***	+ ***	+ ***	+ ***

NOFDEPENDENTS	+	+ ***	+ ***	+ ***	+ ***
COMMISSIONING SOURCE					
ACADEMY	BASE	BASE	BASE	BASE	BASE
ROTCSCHOLAR	-	- ***	- ***	- ***	- ***
ROTCNONSCHOLAR	-	+	+ ***	-	+ ***
OCS	-	- ***	+ ***	- ***	+ ***
DIRAPPOINT	-	- ***	- ***	- ***	- ***
OCCUPATION					
IACF (Infantry + Armor + Cavalry + Field Artillery)	BASE	BASE	BASE	BASE	BASE
AVIATION	+	+ ***	+ ***		
AIRDARTILLERY	-	- ***	- ***		
INTELLIGENCE	-	- ***	- ***		
ENGINEERING	-	- ***	- ***		
SPECIAL	-	- ***	-		
ADMINISTRATIVE	-	- ***	- ***		
MILPOLICE	-	-	-		
LOGISTICIAN	-	- ***	- ***		
SUPPLY	-	- ***	- ***		
TRANSPORTATION	-	- ***	- ***		
OTHERMO	-	- ***	- ***		
OCCUPATION CATEGORY					
COMBATARMS	BASE	BASE	BASE	BASE	BASE
COMBATSUPPORT	-			- ***	- ***
COMBATSERVICESUPPORT	-			- ***	- ***
SPECIALBRANCHES	-			- ***	- ***
CAREER CHARACTERISTICS					
PRIORENLISTED	+	-	+ ***	-	+ ***
EDUCATION					
GRADEDUCATION	+	+ ***	+ ***	+ ***	+ ***

*	Significant at 0.10 level
**	Significant at 0.05 level
***	Significant at 0.01 level

Positive signs in LIFEREG models indicate that the expected service time for that variable is longer than the base case. The opposite is true for negative signs. Positive signs in the PHREG models indicate that the hazard of leaving is smaller than 1 which shows that the hazard for that variable is less than the hazard for the base case. The opposite is true for the negative signs.

All of the year variables except for FY86 and FY87 indicate that the officers commissioned through FY82-FY01 have longer expected service times when compared to the officers commissioned in FY81 which is the base year. FY86 and FY89 are not significant in any of the models.

In order to see whether the service times for different commissioning sources are significantly different from each other, regressions with different commissioning sources as the base case were run. All of the differences between commissioning sources results were statistically significant except for the difference between OCS and ROTCNONSCHOLAR and between OCS and ROTCNONSCHOLAR.

In this study all of the commissioning source variables are found to be statistically significant in PHREG models but in all of the LIFEREG models, the ROTC Non-Scholarship variable is not statistically significant. PROC PHREG estimates the Cox proportional hazard model, which is the most widely used procedure for survival analysis. For the PROC PHREG procedure, there is no need to choose a particular probability distribution to represent survival times and it is easy to incorporate time-dependent covariates that may change over the observation period[131]. That is why the PHREG procedure is often preferred to the LIFEREG procedure for survival analysis. For these reasons, the results of the PHREG models are preferred to those of the LIFEREG models in this study.

B.   CONCLUSIONS

1.   Comparison of Army and Navy Survival Analysis Results

In his study of Navy officer survival, Korkmaz (2005) found patterns and relationships that are similar to those found in this study for the Army. The LIFETESET results indicate that commissioning source has a significant effect on the survival curves of commissioned officers in both of the studies. In his LIFEREG results, Korkmaz (2005) pointed out that, controlling for the other covariates, all of the commissioning sources have shorter expected service times than the base case, which is United States Naval Academy (USNA). The results of this study are the same except for the results for the ROTC Non-Scholarship graduates when compared to USMA graduates (the base case). Being an ROTC Non-Scholarship graduate is not found to have a significant effect on the expected service time in this study. The PHREG results are also similar for the Navy and Army studies. Korkmaz (2005) indicated that all of the officers graduating from commissioning sources other than ROTC Non-Scholarship have greater hazards of

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[131] Paul D. Allison, *Survival Analysis Using SAS* (SAS Publishing, North Carolina, 2003), 111, 112.

leaving than United States Naval Academy (USNA) graduates while this study shows that all of the officers graduating from commissioning sources other than ROTC Non-Scholarship and OCS have greater hazard of leaving than USMA graduates. Therefore the only difference between the results of these two studies is for the ROTC Non-Scholarship graduates in the LIFEREG results and for the OCS graduates in the PHREG results. All of the other findings for the commissioning sources are parallel.

Korkmaz found that, for the Navy, occupation category variables affect survival rates. The results of this study are similar and indicate that all of the occupation and occupation category variables have significant effects on the survival functions of commissioned officers except for the special and military police occupations.

## 2.	Comparison of the Results with the Literature

Age, race and ethnicity (except for the variable HISPANIC), gender, marital status, number of non-spousal dependents, and graduate education are all found to have significant effects on the survival function in this study. These results are consistent with the results of Korkmaz (2005), Hosek, et al. (2001), Hoglin (2004), and Cerman and Kaya (2005).

In some of the models in this study being prior enlisted has a negative sign. However it is not statistically significant in those models. In every model where being prior enlisted is significant, it is found to have a positive effect on the survival function which is also consistent with the literature. In the literature there are different findings about effects of being prior enlisted on service time. There are studies which found that prior enlisted officers have a longer service time.[132] However, there are also some studies that have found that being prior enlisted does not seem to affect retention and promotion.[133]

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[132] Joel P. Bernard, *An Analysis of Alternate Accession Sources for Naval Officers*, (Monterey, California: Naval Postgraduate School, May 2003).

[133] Zafer Kizilkaya, *An Analysis of the Effect of Commissioning Sources on Retention and Promotion of U.S. Army Officers.*

Some Army studies have found no significant effect of occupation category on retention and promotion.[134] However, in this study all of the occupation and occupation category variables, except for the special and military police occupations, are found to have significant effects on the survival functions of commissioned Army officers.

C.   RECOMMENDATIONS

The hypothesized effects for some of the commissioning sources are different from the observed effects in some of the models in this study. USMA was expected to have the longest service time and the lowest hazard of leaving. In the LIFEREG models, USMA graduates are found to have the longest service time which is consistent with the hypothesized effect. However, the PHREG results indicate that ROTC Non-Scholarship and OCS graduates have lower hazards of leaving than USMA graduates. This may be due to several different reasons. The cost per graduate is high for USMA students and, as a result, USMA graduates receive an excellent education that may provide very attractive job opportunities in the civilian labor market after obligatory service is completed. This might explain why they are more likely to leave than non-scholarship ROTC and OCS graduates. Another reason for leaving may be the differences between what USMA graduates expect from the Army and what they find. Most OCS officers have experience as prior service enlistees and so may have more realistic expectations about the military. This may lead to longer service for the OCS graduates compared to USMA graduates.

The results of this study have implications for personnel planning issues. There are large differences in cost per graduate among the commissioning sources and also, as this study shows, there are significant differences in length of service and the hazard of leaving for commissioning sources. Therefore, cost per graduate and the expected time in service should both be taken into account when making decisions about the Army's mix of commissioning sources. The finding that officers who have graduate degrees have substantially longer service times (2.39 times longer) and a lower hazard of separation (19.1 %) than officers who do not indicates that the use of educational benefits to encourage officers to stay in service longer may be another important issue in personnel

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[134] Zafer Kizilkaya, *An Analysis of the Effect of Commissioning Sources*

planning. For the commissioning sources that have shorter expected service times, new educational benefits might be used to increase the length of service.

This study has some limitations. The data set used in the study has some deficiencies. The commissioning source of almost 22,000 officers is unknown. Separation age, entry age, years of commissioning service, date of separation, and date of entry are not entirely reliable. Therefore, the duration variable had to be generated by counting the valid pay grades for officers. In this process, observations with gaps in yearly pay grades were deleted. Also, a distinction couldn't be made between the infantry, armor, field artillery and cavalry officers. Therefore, a single variable is used to represent them. Another issue is the lack of performance variables such as officer evaluation reports and fitness reports, which may lead to omitted variable bias. These issues may decrease the reliability of the results reported in this thesis. All of these issues should be addressed in future studies.

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